REGISTER

OF

LEHIGH UNIVERSITY

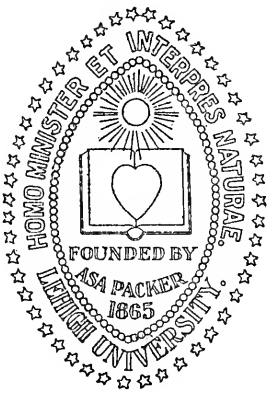
1904-1905.

SOUTH BETHLEHEM, PA.

REGISTER

OF

LEHIGH UNIVERSITY



1904-1905.

SOUTH BETHLEHEM, PA.

1904.

JULY.

S	M	T	W	T	F	S
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AUGUST.

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SEPTEMBER.

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OCTOBER.

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NOVEMBER.

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DECEMBER.

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1905.

JANUARY.

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FEBRUARY.

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MARCH.

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APRIL.

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MAY.

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JUNE.

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JULY.

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AUGUST.

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SEPTEMBER.

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OCTOBER.

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NOVEMBER.

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DECEMBER.

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1906.

JANUARY.

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FEBRUARY.

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MARCH.

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APRIL.

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MAY.

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JUNE.

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24	25	26	27	28	29	30
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CALENDAR.

1904–1905.

1904.

Sept. 17, 19, 20,	Examinations for Admission.
Sept. 21, 3.30 P.M.,	First Term begins.
Oct. 13,	Founder's Day.
Nov. 23, 12.00 M.,	Thanksgiving Recess begins.
Nov. 28, 8.15 A. M.,	Thanksgiving Recess ends.
Dec. 23, 12.30 P. M.,	Christmas Holidays begin.

1905.

Jan. 5, 8.15 A. M.,	Christmas Holidays end.
Feb. 6, 8.15 A. M.,	Second Term begins.
Feb. 22,	Junior Oratorical Contest.
April 19, 12.30 P. M.,	Easter Holidays begin.
April 27, 7.45 A. M.,	Easter Holidays end.
May 30,	Memorial Day (half holiday).
June 11,	Baccalaureate Sunday.
June 12,	Class Day.
June 13,	Alumni Day.
June 14,	University Day.
June 15,	Summer Term begins.
June 15, 16, 17,	Examinations for Admission.

1905–1906.

1905.

Sept. 16, 18, 19,	Examinations for Admission.
Sept. 20, 3.30 P.M.,	First Term begins.
Oct. 12,	Founder's Day.
Nov. 29, 12.00 M.,	Thanksgiving Recess begins.
Dec. 4, 8.15 A. M.,	Thanksgiving Recess ends.
Dec. 22, 12.30 P. M.,	Christmas Holidays begin.

1906.

Jan. 4, 8.15 A. M.,	Christmas Holidays end.
Feb. 5, 8.15 A.M.,	Second Term begins.
June 13,	University Day.

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Died December 31, 1904.

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* Died November 16, 1904.
† Died January 4, 1905.

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LEHIGH UNIVERSITY.

ORIGIN.

The Hon. Asa Packer, of Mauch Chunk, during the year 1865, appropriated the sum of $500,000, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the Lehigh Valley. On this foundation rose Lehigh University, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Marine, Metallurgical, Mining, Electrical, and Chemical Engineering, Electrometallurgy, Chemistry, Geology, Physics, and in all needful collateral studies. A thoroughly equipped School of General Literature was also established, including the Classical and Latin-Scientific courses.

SITE.

South Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central, and the Philadelphia and Reading Railroads, and the University buildings are about a half-mile from the station. New York is eighty-nine and Philadelphia fifty-seven miles distant.

The situation of the institution is healthful and beautiful. The region is famous for its mines and its railway and manufacturing enterprises.

TUITION AND OTHER FEES.

For students in the courses of Civil, Mechanical, Marine, Metallurgical, Mining, Electrical, and Chemical Engineering, Electrometallurgy, and Geology, the tuition fee is $150 for the year or $90 for either term; for students in the courses of Chemistry and of Physics, $100 for the year or $60 for either term; for students in the School of General Literature, $60 for the year or $40 for either term. A graduation fee of $10 must be paid by all candidates for a degree.

The special fees for materials and apparatus used in the various laboratories, etc., are given in connection with the description of the subjects under the List of Studies.

The tuition fees are payable to the Treasurer of the University in two instalments, on the opening day of the college year in September, and on the first day of the second term in February. The first instalment is $90, $60, or $40, according to the course, and the second $60, $40, or $20. Application may be made for a return of part of the tuition fee when a student has formally withdrawn from the University after less than four weeks' attendance in either term, but the amount thus refunded will in no case exceed one-half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

PUBLIC WORSHIP.

Morning prayers are held in the Packer Memorial Church of the University, at which attendance is required.

BUILDINGS.

PACKER HALL.

This building, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture, and occupies a commanding position, overlooking Bethlehem and South Bethlehem.

The department of Civil Engineering occupies the greater part of the basement, first floor, and second floor of Packer Hall. In the basement are the testing laboratories for cement, brick and

metals, which contain four machines for tensile and compressive tests, one for torsion tests, and special apparatus for experimental work. On the first floor are two recitation rooms, a large drawing hall, two instrument rooms, two offices and a library room. The instrument rooms contain seventeen transits, twelve levels, a large geodetic theodolite, and other tools for engineering field work. In the library room is an excellent collection of plans of engineering structures. On the second floor are two drawing rooms, two recitation rooms, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the departments of Mathematics and Modern Languages. The museum of Geology and Natural History is also on the third floor.

This building contains also the lecture and recitation rooms of the departments of Greek and Latin.

THE CHEMICAL AND METALLURGICAL LABORATORY.

This is a thoroughly fire proof building, built of sandstone, 219 feet in length by 44 in width, with a wing.

In the Chemical department there are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum, and laboratories for organic, physiological, agricultural, and sanitary chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air pump for vacuum filtration, etc.

Photographic and microscopical laboratories are located in the third story of the central portion of the building.

The Mineralogical and Metallurgical departments contain a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical demonstration of crystals and minerals; a museum for mineralogical and metallurgical collections; a mineralogical laboratory provided with a Fuess reflecting goniometer, Goldschmidt's "two-circle" reflecting and application goniometers, a polariscope, a Groth's "universal apparat," and a Rosenbusch polarizing microscope; a dry laboratory pro-

vided with furnaces for solid fuel and for gas with natural draught and with blast, electric current for electrometallurgical experiments, and a wet laboratory for ordinary analytical work. Equipment has recently been provided for laboratory work in metallurgy and particularly in electrometallurgy, consisting in working places for students, each equipped with gas, electric current, and apparatus for various kinds of experimental work, while several new pyrometers and electric furnaces have been added to the general equipment. These departments are therefore very well arranged and equipped for the instruction of classes in the courses of mineralogy, metallurgy, and blowpipe analysis of the regular curriculum, and to afford facilities to students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

THE PHYSICAL AND ELECTRICAL ENGINEERING LABORATORY.

This building is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the two dynamo laboratories of the Electrical Engineering department, the work-shop, storage battery room, standardizing laboratory and six research rooms belonging jointly to the departments of Physics and Electrical Engineering.

The dynamo laboratory for Junior students in the east wing is supplied with power from an 8-horse-power steam engine and a 15-horse-power electric motor.

The dynamo laboratory for Senior students in the west wing is supplied with power from a 50-horse-power steam engine. The dynamo laboratory equipment includes a 25 kilowatt double-current generator supplying both direct and alternating current, a Brackett cradle dynamometer, two 7½ kilowatt rotary converters, two arc light dynamos, twenty direct current dynamos and motors ranging from 1 horse-power to 15 horse-power, three alternators, including a 10 kilowatt Ferranti machine and a 35 kilowatt Westinghouse machine, twelve transformers from 1 to 5 kilowatts capacity, and a variety of instruments including voltmeters, ammeters, wattmeters, rheostats, contact makers, dynamometers, condensers, and other apparatus.

On the second floor are the offices of the departments of Physics and of Electrical Engineering, two general apparatus rooms, two large laboratory rooms for physics, including four photometer rooms, a drafting room and a seminary room for electrical engineering.

On the third floor are the physics lecture room, with apparatus rooms adjoining, photographic and photometer rooms, a recitation room, and a large audience hall.

On the fourth floor, well lighted by dormer windows and skylights, are four recitation rooms in the central portion of the building, a large drawing room and a blue-print room in the east wing, and a large physical laboratory room in the west wing.

STEAM ENGINEERING LABORATORY.

This is a new, well lighted, two-story building of Potsdam sandstone, 90 feet long and 44 feet wide. It is divided into two sections, one for boilers and the other for engines. The former can accommodate three 100-horse-power high-pressure boilers and the latter the various steam motors and their accessories. In this experimental power plant are contained a triple-expansion engine, a tandem-compound marine engine, a high-speed Ball engine (Erie, Pa.), coupled to a 25 K. W. Crocker-Wheeler generator, an Ingersoll-Sergeant Drill Co. air compressor which is compound at both air and steam ends, with reheating and cooling devices attached, and a DeLaval steam turbine that is combined with a centrifugal pump. The accessories are a Wilson-Snyder steam pump, a Blake pump, a Worthington circulating pump, a "Featherweight" air pump, a Cochrane feed-water heater and three Cochrane steam separators, also box-coil condensers, a Wheeler surface condenser, and Wainwright surface condenser. There is a complete set of Westinghouse air brake apparatus, including the pump and engineer's valve, and several sets of the parts belonging to freight cars. In addition there are water meters, weighing tanks, and dynamometers for measuring the steam consumption and the development of power. Other experimental work is conducted in the basement of Williams Hall.

WILLIAMS HALL.*

This building is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the department of Mechanical Engineering and the other half to Geology, Biology, and Mining Engineering.

*Named for Prof. E. H. Williams, jr.

In the eastern end are located the recitation rooms, instructors' offices, drawing rooms, reference library, and store rooms of the department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiencies of hoisting and other gear, and the testing of motors and other prime movers than steam engines. In this section there are 4-cycle and 2-cycle gas engines, hot-air pumping engines, electric motors, a water motor, a 15-horse-power centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the department of Geology has on the first floor two lecture rooms, office, library, and laboratory of petrology. The larger of the two lecture rooms is fitted with collections of fossils, rocks, and economic minerals; the smaller room is equipped with a study collection of rocks containing over five thousand specimens collected from the type regions in different parts of the world; both rooms are fitted with stereopticon for illustrated lectures. The laboratory of petrology is provided with twelve high-grade petrographic microscopes, a microprojection apparatus for lecture purposes, and study collections of rocks and thin sections. In the basement are rooms devoted to working collections and field equipment for Geology and Economic Geology, and an apparatus for cutting thin sections of rocks, with a one horse-power motor for furnishing power. On the third floor is a laboratory devoted to the use of students of field geology.

The department of Mining Engineering has its office, library, and recitation rooms on the first floor. A large room in the well-lighted basement is used for illustrative material and among other things contains an Ingersoll-Sergeant Rock Drill, a Sullivan hand-power diamond drilling machine, and a Phillips Automatic Cross-over Car Dump with a full sized mine car. The equipment for Mine Surveying contains, among other instruments, a complete C. L. Berger & Son's mining transit with auxiliary top and side telescope and solar attachment, a Heller & Brightly 18-inch Y-level with latest improvements, a Gurley monocular hand level, and other accessories. On the third floor is a well equipped blueprint and dark room and photographic laboratory used jointly by the Geological and Mining Departments.

The department of Biology has its lecture room, store rooms, office, reference library, and laboratories on the second floor, and a large vivarium on the third floor. The laboratories of this department are thoroughly equipped with collections, sections, microscopes, and necessary appliances.

On the third floor of the building is located an assembly hall seating about 400.

Two students' rooms, used by the Mining and Geological Society and by the Mechanical Engineering Society, are located in the basement.

SAUCON HALL.

Extensive alterations to this building were made in 1896, adapting it to the needs of the departments of English and of History and Economics. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the Debating Society, with committee rooms adjoining.

CHRISTMAS HALL.

In this building are found the drawing rooms of the Mining and Metallurgical departments and the halls of the Young Men's Christian Association. On the ground floor is a Supply Bureau conducted by students of the University.

THE SAYRE OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an astronomical observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the observatory is mounted an equatorial telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a sidereal clock, by Wm. Bond & Sons; a zenith telescope, by Blunt; and a field transit, by Stackpole. There is also a prismatic sextant, by Pistor & Martins.

Students in practical astronomy receive instruction in the use of the instruments and in actual observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by Charles Brodhead, Esq., of Bethlehem.

Sayre Observatory Annex.

This building contains a modern zenith telescope of four inches clear aperture equipped with electric illumination. The building and instruments were presented to the University by Robert H. Sayre, Esq., July 23, 1903.

Observations secured with this instrument are for the purpose of investigating the Variation of Latitude.

THE PACKER MEMORIAL CHURCH.

The Packer Memorial Church is the munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is one of the largest and most magnificent churches in the State.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of $100,000, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than $20,000 was contributed by her family and friends as a memorial fund for the purchase of books.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior the center is occupied by a reading space, 40 by 50 feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fire-proof, well lighted, and heated by steam.

One hundred and twenty-three thousand volumes are now upon the shelves, including many extremely valuable books. The list of periodicals numbers about four hundred, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

The Eckley B. Coxe Memorial Library.

In memory of the Honorable Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe has presented to the University his technical library, consisting of 7727 volumes, together with

3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

THE GYMNASIUM.

The Gymnasium is a spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus and two handball courts, and is provided with hot and cold water, and shower baths, and 515 clothes closets.

ATHLETIC FIELD.

An athletic field is provided by the University for the accommodation of students who wish to participate in the various outdoor sports. Football, baseball, and lacrosse fields are provided, also a quarter-mile running track. Bleachers and grandstands furnish seating capacity for 7500 spectators.

A Field House, fitted with 80 steel lockers and 10 hot and cold water shower baths supplied by pure spring water, furnishes accommodations for the various athletic teams.

A Cage with 60 by 120 ft. floor space is provided for indoor baseball, lacrosse, and track and field sports practice.

All athletic sports are directed and controlled by an Athletic Committee composed of Faculty, Alumni, and student members.

EXPENSES.

Books, stationery, and drawing instruments are provided by the student. Materials consumed in the laboratories can be obtained from the University, their value being covered by a deposit or fee made at the opening of that term in which the laboratory work is to be done. These fees and deposits for the various laboratories are given under the detailed statement of laboratory courses in the List of Studies.

Rooms and board cannot be had in the University buildings, but can readily be obtained in many private houses in South Bethlehem and Bethlehem.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $350 to $500. This includes attendance at the required summer schools.

Information concerning scholarships and financial aid may be obtained from the Registrar. No applications will be considered after September 1st.

Fee for Special Examinations.—Special examinations, granted by the Faculty to students at their request, are subject to a fee of five dollars, which is added to the President's Fund for the aid of indigent students.

DATE OF EXAMINATIONS.

Examinations for admission to the University will be held in 1905 on Thursday, Friday and Saturday, June 15, 16, and 17, and on Saturday, Monday, and Tuesday, September 16, 18, and 19.

The examinations are held in June and September in the following order:

First Day.—Geometry, 8:00 A.M.; Physics, 2 P.M.; Latin and Roman History, 2 P.M.

Second Day.—Algebra, 8:00 A.M.; English, 2 P.M.

Third Day.—Trigonometry, 8:00 A.M.; American History, 11 A.M.; German or French, 2 P.M.; Greek and Greek History, 2 P.M.

Candidates for admission wishing to obtain credit for any subject of the first term of the Freshman year should notify the Registrar before September 15. There will be an examination in Elementary Chemistry on September 20, 1905, at 8 A M.; those passing this examination will take Stoichiometry during the first term.

Examinations are held for admission to the Sophomore Class at the beginning of the first term; information as to these examinations may be obtained from the Registrar.

The examinations cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age, and must present a testimonial of good moral character from his latest instructor.

Certificates of the College Entrance Examination Board are accepted in lieu of the entrance examinations held at the University in those subjects in which the recorded grade is C (60 per cent.) or over.

THE SCHOOL OF GENERAL LITERATURE.

THE CLASSICAL COURSE.

Candidates for admission to the Classical Course are examined in the following subjects:

1. *English.*—This requirement includes: (*a*) *English Grammar*, especial attention being given to the analysis and correction of sentences; and (*b*) *Rhetoric* and *Composition.* Any approved High School Rhetoric will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct punctuation, clearness and facility in expression and in the presentation of ideas, an acceptable style of writing—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books suggested by the Joint Committee of Colleges and Preparatory Schools for admission to the colleges of the Middle States. From one of the last four books in their list a theme will be taken for the composition which forms a part of the examination paper.

History.—This requirement includes: (*a*) *Greek History* to the death of Alexander with due reference to Greek life, literature, and art. (As in Botsford, Myers, or Oman, with Mahaffy's Old Greek Life); (*b*) *Roman History* to the accession of Commodus, with due reference to literature and government. (As in Myers's Rome or Allen's History of the Roman People, pp. 1-242, and in Preston and Dodge's Private Life of the Romans); (*c*) *American History,* with the elements of civil government. This includes colonial history, with a view to the origin and development of our institutions, and the period of discovery and early settlement, so as to set forth the relations of peoples in America and the meaning of the struggle for mastery. (As in Channing, McMaster, Thomas, or McLaughlin.) Throughout this examination special emphasis will be laid on knowledge of the physical and political geography of the countries concerned.

3. *Algebra.*—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Plane Geometry.*—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric units.

5. *Latin Grammar.*

6. *Caesar,* four books of the Gallic War.

7. *Cicero,* six orations, including the four against Catiline.

8. *Vergil,* the first six books of the Aeneid, including Prosody.

9. The translation, at sight, of passages from Caesar and Cicero.

10. The translation of English into Latin.

11. *Greek Grammar.*

12. *Xenophon,* Anabasis, four books.

13. *Homer,* Iliad, first three books, including Prosody. The Catalogue of Ships may be omitted.

14. The translation, at sight, of a passage from some work of Xenophon.

Candidates for admission to the Classical Course who have had, in their preparatory schools, no opportunity of studying Greek, are, at present, admitted to that course in full standing upon presenting in lieu of Greek an amount of German or French equivalent to two years' work. They will begin Greek in the Freshman year and study it throughout the course.

THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first ten of the above requirements, but substitute for the Greek sections (numbers 11-14 inclusive) the following work:

15. *Solid Geometry.*

16. *Plane Trigonometry and Logarithms.*—Through the solution of right and oblique triangles. Candidates must bring their logarithmic tables to the examination.

17. *German* or *French.* This requirement will be satisfied by the completion of an amount of German equivalent to Part I of Joynes-Meissner's or Calvin Thomas's Grammar, and Buchheim's Reader, Part I, together with about 500 pages of standard German authors; or, if French is offered, an amount equivalent to Whit-

ney's Practical Grammar and Super's Reader, together with about 800 pages of modern French authors. This requirement implies, in general, two years' academic work.

The candidate is expected to have acquired the ability to read German or French prose and poetry of ordinary difficulty. His proficiency will be tested by questions on Grammar, by translation of simple English sentences into German or French, and by translations at sight of passages containing no rare or unusual words.

THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Marine Engineering, Metallurgical Engineering, Electrometallurgy, Mining Engineering, Electrical Engineering, Analytical Chemistry, Chemical Engineering, Geology, and Physics are examined in the following subjects:

1. *English.*—This requirement includes: (*a*) *English Grammar*, especial attention being given to the analysis and correction of sentences; and (*b*) *Rhetoric* and *Composition.* Any approved High School Rhetoric will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct punctuation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books suggested by the Joint Committee of Colleges and Preparatory Schools for admission to the colleges of the Middle States. From one of the last four books in their list a theme will be taken for the composition which forms a part of the examination paper.

It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *American History,* with the elements of civil government. This will include colonial history, with a view to the origin and development of our institutions, and the period of discovery and early settlement, so as to set forth the relations of peoples in America and the meaning of the struggle for mastery. (As in

Channing, McMaster, Thomas, or McLaughlin.) Throughout this examination special emphasis will be laid on knowledge of the physical and political geography of the countries concerned.

3. *Algebra.*—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Evolution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Geometry.*—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles. Solid geometry.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric units.

5. *Plane Trigonometry and Logarithms.*—Through the solution of right and oblique triangles. Candidates must bring their logarithmic tables to the examination.

All mathematical subjects should be thoroughly reviewed in the last year's work of the Preparatory school.

6. *Elementary Physics.*—This requirement may be met by a good course in any of the standard High School text-books in Physics, such as Gage's Elements of Physics, Carhart and Chute's Physics, or Avery's Elements of Natural Philosophy. Ability to solve simple numerical problems is required. In case the candidate has done laboratory work in Physics he should submit his laboratory note book at the time of his examination for entrance.

7. *German.*—This requirement will be satisfied by the completion of an amount equivalent to Part 1 of Joynes-Meissner's or Calvin Thomas's Grammar, Buchheim's Reader, and additional reading.

An equivalent amount of French will be accepted in cases in which it is inconvenient for the candidate to offer German. The amount thus required in French is equivalent to Whitney's Practical Grammar and Super's Reader, with additional reading.

The candidate is expected to have acquired the ability to understand simple German (or French) prose, by the careful reading of about two hundred duodecimo pages, in addition to the study of Grammar. His proficiency will be tested by questions

on the rudiments of Grammar, by translations of simple English sentences, and by translations at sight of passages of easy German (or French) prose, containing no rare words.

DIVISION OF EXAMINATIONS FOR ADMISSION.

Candidates for admission to the Freshman Class may pass all the examinations in June, or all in September, or some in June and the rest in September of the year of entrance, or may take them in *two consecutive years.* In the last case, for all courses candidates may present themselves for examination in the first year in the following subjects: Plane Geometry, English, and History. In addition, candidates for the Classical and Latin-Scientific Courses may present Latin: Grammar, Caesar, Cicero; and one of the following: (*a*) Greek: Grammar and three books of Anabasis; (*b*) German: the equivalent of one year's work; (*c*) French: the equivalent of one year's work.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

ADMISSION TO ADVANCED STANDING.

Candidates for admission to advanced studies in any course are required to pass, *in addition to the entrance examinations for that course,* examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman Class. The additional subjects may be found in the schedule of studies of the different departments.

A student from another College or University is admitted without entrance examinations, provided he has covered the entrance subjects required at this University. Evidence to that effect, together with a letter of honorable dismissal from his college, should first be filed with the Registrar. If these are satisfactory, the applicant will receive a certificate that the entrance requirements of this University are satisfied.

Applicants who have obtained this certificate and who desire to enter the Freshman or Sophomore class in February, must report personally to the Secretary of the Faculty on or before the Wednesday preceding the opening of the second term. Those who desire to enter the Sophomore or Junior class in September

must report personally in June not later than the Thursday preceding University Day, or in September not later than the Thursday preceding the opening of the first term. For those applying after these dates an entrance fee of twenty-five dollars will be charged.

The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects already taken by the class that he desires to enter. It is necessary for an applicant to bring a certificate naming the subjects completed at another college, together with a copy of the catalogue or register of the college; and it is desirable for him to bring samples of his drawings, field notes, computations and laboratory work for inspection, and personal certificates from his teachers showing the grades attained at the college from which he comes. Professors may admit the student to advanced standing if satisfied with these evidences of proficiency, or they may find it necessary to give a formal examination in the subjects for which he desires credits.

Professors will note their conclusions on the paper furnished the applicant, who must return the same to the Secretary of the Faculty within three days from its date of issue. If all the subjects are accepted, the applicant will be admitted in full standing to the Freshman, Sophomore, or Junior Class, as the case may be. If nearly all are accepted, the candidate may be admitted with conditions, and the Secretary of the Faculty will inform him of the rules applicable to conditioned students.

ADMISSION TO GRADUATE COURSES.

Students of this University who have taken their first degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found on page 29 under the general subject of Graduate Courses.

PREPARATORY SCHOOL CERTIFICATES.

The University has no permanent arrangement with any preparatory school whereby certificates are accepted in lieu of entrance examinations, and the acceptance of certificates for any student in any subject must be the result of a special arrange-

ment between the Principal of the school and the Registrar of the University.

EXAMINATIONS AT SCHOOLS.

When desired by the Principals, arrangements will be made to hold at the schools the June examinations for admission to the University. Such requests should be made before June 1st.

LIST OF STUDIES.

Following is a complete list of studies offered by the University in its various courses. The number of exercises per week in each subject is indicated by the figure in parentheses. Two hours of drawing, three of work in the laboratory or three of practice in the field are regarded as equivalent to a recitation or lecture of one hour's duration.

GRADUATE COURSES.

The degree of Master of Arts is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Arts at any College or University, shall pursue for at least one year at this University a course of liberal study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

In exceptional cases graduates of this University who are candidates for the degree of Master of Arts will be allowed to study in non-residence.

The degree of Master of Science is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Science or a degree in technology at any College or University, shall pursue for at least one year at this University a course of advanced study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

The tuition fee is $50 a year and the graduation fee is $10. No tuition is charged to students pursuing graduate work in non-residence, but the graduation fee is $30, and at least two years are required to complete the course.

The course of study may be selected, with the approval of the Faculty, from the following list of subjects, at least fifteen exercises per week being chosen in two departments. About two-thirds of the work is to be in one department and about one-third in another, these being called major and minor departments. The thesis is to be prepared on a subject connected with

the studies of the major department. The candidate is required to satisfy each professor that he is fully competent to pursue the subjects selected.

The following subjects are now offered by the University; other allied subjects may in some cases be selected by candidates after conference with the professors in charge.

Candidates who desire to receive the Master's degree in June of 1906 are required to confer with the professors on or before September 23, 1905, and to present their courses of study to the Faculty for approval on September 25, 1905.

IN CHEMISTRY.

Advanced Industrial Chemistry.

PROFESSOR CHANDLER.

This course involves the study of some industry dependent upon chemical principles and consists of practical experimental and analytical work in the laboratories, inspection of manufacturing establishments, and study of the technical journals and other publications. Two terms. (10)

Advanced Organic Chemistry.

ASSISTANT PROFESSOR SCHOBER.

This course consists of original investigations in organic chemistry. Two terms. (10)

Advanced Inorganic Chemistry.

ASSISTANT PROFESSOR ULLMANN.

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms. (10)

The Rare Elements.

MR. BUCH.

The study of the properties and reactions of these elements and the preparation of some of their salts. Two terms. (10)

IN MINERALOGY.

Geometric Crystallography.

PROFESSOR FRAZIER.

An advanced course in mathematical crystallography, including practical instruction in the measurement, calculation, projec-

tion and drawing of crystals. Reference books: Mallard's Crystallographic Géométrique and Liebisch's Geometrische Krystallographie. First term. (5)

Physical Crystallography.

PROFESSOR FRAZIER.

A description and discussion of the physical properties of crystals, with practical instruction in the determination of the optical constants of crystals. Reference books: Mallard's Crystallographie Physique, Liebisch's Physikalische Krystallographie, Groth's Physikalische Krystallographie. Second term. (5)

IN CIVIL ENGINEERING.

Bridge Design.

PROFESSOR MERRIMAN.

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparisons of different types. Two terms. (4)

Testing of Materials.

PROFESSOR MERRIMAN.

The properties of materials of construction, with special reference to inspection and testing. The student will conduct original researches in the laboratory. The work on the unification of methods of testing done by the International Association for Testing Materials will receive detailed attention. Two terms. (5)

Railroad Engineering.

ASSISTANT PROFESSOR WILSON.

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with the detailed discussion of special cases. Two terms. (2)

Sanitary Engineering.

ASSISTANT PROFESSOR WILSON.

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms. (4)

IN MODERN LANGUAGES.

French.

PROFESSOR RINGER, ASSISTANT PROFESSOR GAUSS.

An advanced course in the French language, consistinig of historical and advanced grammar, and literature. The course will be arranged with each candidate individually upon application. Two terms. (5) Also see courses 72 and 73, on page 44.

German.

PROFESSOR RINGER, MR. PALMER.

An advanced course in the German language, consisting of historical and advanced grammar, and literature. The course will be arranged with each candidate individually upon application. Two terms. (5) Also see courses 86 and 87, on page 46.

IN MATHEMATICS AND ASTRONOMY.

Practical Astronomy.

PROFESSOR THORNBURG.

The work embraces: (*a*) The study of instruments and methods used in the determination of time, latitude, longitude, and azimuth; (*b*) Practical work in the observatory, securing facility in making and reducing observations. Two terms. (4)

Analytical Mechanics.

ASSISTANT PROFESSOR MEAKER.

This course is based on Ziwet's Theoretical Mechanics and Routh's Dynamics of a System of Rigid Bodies. Two terms. (3)

Differential Equations.

ASSISTANT PROFESSOR LAMBERT.

The course in Differential Equations is based on Johnson's Differential Equations and Byerly's Spherical Harmonics. Collateral reading in the University Library is required. Two terms. (3)

IN ENGLISH.

English Literature.

PROFESSOR THAYER.

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, the details of which will be arranged after a personal conference. Two terms. (5)

IN PHYSICS.

Theoretical Physics.

PROFESSOR FRANKLIN.

This embraces: (*a*) The theory of heat, based upon Preston's Theory of Heat and Buckingham's Thermodynamics; (*b*) The theory of electricity and magnetism, based upon Maxwell's Treatise, J. J. Thompson's Recent Researches, and Webster's Electricity and Magnetism; or (*c*) The theory of light and sound, based upon Preston's Theory of Light and Helmholtz's Tonempfindungen. Two terms. (4)

Physical Research.

PROFESSOR FRANKLIN.

This course consists of original investigations in experimental physics. Two terms. (3)

IN HISTORY AND ECONOMICS.

Political Economy.

PROFESSOR STEWART.

This course embraces: (*a*) The rise and development of economic systems and economic thought. (*b*) The scope and method of political economy. Patten's Development of English Thought and the works of Keynes, Cohn, and Ingram on Political Economy will be used. Two terms. (5)

American History.

PROFESSOR STEWART.

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms. (5)

Politics.

PROFESSOR STEWART.

The history of the attempt to treat in a systematic way the problems of political organizations. Pollock's History of the Science of Politics and Sidgwick's Elements of Politics. Two terms. (5)

IN LATIN.

Roman Law.

PROFESSOR BLAKE.

(*a*) Roman law before Justinian; based on Bruns's Fontes Juris Romani Antiqui, and Mommsen's Abriss des römischen Staatsrechts. (*b*) Justinian's Institutes, Morey's Outlines of Roman Law, and collateral reading. Two terms. (4)

Roman Philosophy.

PROFESSOR BLAKE.

(*a*) Cicero, De Legibus and De Natura Deorum; History of Roman Philosophy. (*b*) Selected readings from Seneca. Two terms. (3)

Roman Literature.

PROFESSOR BLAKE.

(*a*) History of Roman literature. (*b*) Readings from Latin authors not previously read in course, as far as practicable paralleling the work in (*a*). Two terms. (3)

IN GREEK.

Hellenistic Greek.

PROFESSOR GOODWIN.

Gospel of St. Mark, Acts, and selected Epistles of the New Testament. Thayer's Lexicon. Blass's Grammar of New Testament Greek. Patristic literature. Collateral reading. Selections from Lucian. Two terms. (5)

Dramatic Poetry.

PROFESSOR GOODWIN.

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's Poetics. Collateral reading. Two terms. (5)

Greek Philosophy.

PROFESSOR GOODWIN.

Plato's Republic and other works. Aristotle, selections. Ritter and Preller's Historia Philosophiae Graecae. Zeller's History of Greek Philosophy, and other collateral reading. Two terms. (5)

IN ELECTRICAL ENGINEERING.

Theory of Alternating Currents and Alternating Current Machinery.

PROFESSOR ESTY.

This course is based upon the works of Arnold, of Bedell and Crehore, of Steinmetz, and of Franklin and Williamson. Two terms. (4)

Electrical Design.

PROFESSOR ESTY.

This course consists of predeterminations by calculation of the characteristics, regulation and performance of electrical machinery. Design of special machines. Two terms. (3)

Electric Traction.

PROFESSOR ESTY, MR. REGESTEIN.

The development of an electric railway project. Design of station and distribution system. Predetermination of motor equipments and run curves for given schedules and traffic. Estimates of cost. Two terms. (3)

Electrical Testing.

PROFESSOR ESTY, MR. REGESTEIN, MR. SEYFERT.

Special experimental researches in electrical engineering; tests of the magnetic properties of iron and steel; investigation of the series single-phase alternating current motor. Two terms. (3)

IN METALLURGY.

Thermo-Chemistry and Thermodynamics of the Metals.

PROFESSOR RICHARDS, MR. LANDIS.

A study of the melting points, boiling points, specific heats, and latent heats of fusion and of vaporization of the metals, from a practical and theoretical standpoint. Also, of the heat

of formation of compounds of the metals, and the relations of these to atomic weights and other chemical and physical properties. Lectures and laboratory work. First term. (5)

THERMO-CHEMISTRY AND PHYSICS OF METALLIC ALLOYS.

PROFESSOR RICHARDS, MR. LANDIS.

A study of the physical and chemical properties of metallic alloys, their melting points, specific heats, latent heat of fusion, heats of formation and microscopic structure. Lectures and experimental work in the same. Second term. (5)

ELECTROMETALLURGY.

PROFESSOR RICHARDS, MR. LANDIS.

A study of the conditions of deposition of pure metals in electrolysis, electrolytic separations, formation of metallic compounds by electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term. (5)

IN PHILOSOPHY AND PSYCHOLOGY.

PSYCHOLOGY.

PROFESSOR WITMER.

An advanced course will be provided for graduate students who can furnish evidence of sufficient preparation.

IN MINING ENGINEERING.

MINING METHODS.

PROFESSOR ECKFELDT.

The study of methods used in a given mining region, or in the production of a given class of mineral, with respect to conditions influencing choice of method, and cost. Two terms. (3)

MINING PLANT.

PROFESSOR ECKFELDT.

The determination of the efficiency of mining machinery of given types under varying conditions. Two terms. (2)

DRESSING PLANT.

PROFESSOR ECKFELDT.

The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of processes. Losses in dressing. Two terms. (2)

IN GEOLOGY.

Geology.

ASSISTANT PROFESSOR IRVING, MR. BROWN.

Field investigation and study of the literature of some special geological problem. This will comprise field and laboratory work on some district in the vicinity of the University. A map of a limited area will be constructed, the microscopic character and general structural features of the rocks which are exposed will be investigated and a thesis or dissertation embodying these results will be presented. Preparation required will depend upon the nature of the problems to be studied. Two terms. (4)

Economic Geology.

ASSISTANT PROFESSOR IRVING.

Advanced work in ore deposits. Study of the literature and of the theories of ore deposition, together with detailed work on the type occurrences of some one of the metallic or non-metallic minerals. The student will be required to make a thorough investigation and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. Preparation required: 251 or 253, also 254 and 261. First term. (6)

Physiography.

MR. BROWN.

The detailed study of physiographic types and processes. Conferences, reports and theses, with work in the laboratory and field. A training in elementary physiography (such as is given in 257) together with some knowledge of general geology is essential. Two terms. (4)

IN BIOLOGY.

Vertebrate Histogenesis and Organology.

ASSISTANT PROFESSOR HALL.

Lectures, reading, and laboratory work. In the laboratory the development of a vertebrate will be carefully followed, beginning with the segmentation of the egg and tracing the history of the germ-layers, organs, and tissues. The organology deals with the association of tissues to form organs. Preparation required: 272, 273, and 274. First term. (3)

UNDERGRADUATE COURSES.

The University offers the following four year courses:

I. In the School of General Literature:

1. The Classical Course.
2. The Latin-Scientific Course.

II. In the School of Technology:

1. The Course in Civil Engineering.
2. The Course in Mechanical Engineering.
3. The Course in Marine Engineering.
4. The Course in Metallurgical Engineering.
5. The Course in Electrometallurgy.
6. The Course in Mining Engineering.
7. The Course in Electrical Engineering.
8. The Course in Chemistry.
9. The Course in Chemical Engineering.
10. The Course in Geology.
11. The Course in Physics.

These courses are described in detail on pages 80 to 123.

PHILOSOPHY AND PSYCHOLOGY.

PROFESSOR WITMER, MR. DAVIS.

1. HISTORY OF ANCIENT AND MEDIEVAL PHILOSOPHY. An outline of the rise and development of philosophy among the Greeks; the early formulation of the distinctive and fundamental conceptions of science, logic, ethics and psychology; a general characterization of the Neo-Platonic, Patristic, and Scholastic philosophy in relation to the institutions and culture of the times. Selected readings from typical philosophers of the times. First term. (2)

2. HISTORY OF MODERN PHILOSOPHY. The rise of modern philosophy and science following the Renaissance; their separate development in the succeeding periods; an examination of the systems of representative thinkers and of leading tendencies in recent European philosophy. Selected readings from British and other philosophic classics. Second term. (2)

3. ANALYTIC PSYCHOLOGY. An introspective and experimental analysis of perception; the role of apperception, memory, atten-

tion, and association; the perception of space; the relation of perception to the sense organs and to the physical stimuli or objects of the environment. Lectures and laboratory work. First term. (2)

4. Physiological Psychology. The relation of mind and brain; the nature of voluntary, automatic, and reflex movements; inherited instincts and acquired habits; impulse and emotions; sensation, memory, and imagination; the structure and functions of the human nervous system; dissection of the brain and experimentation upon voluntary and reflex movements. Lectures and laboratory work. Second term. (2)

5. Genetic Psychology. The development of the individual mind through the combination and organization of sensation and memory; the growth of habits from the conscious and voluntary modification of instincts; the general conditions affecting mental development and retardation in the individual; the biological factors of heredity and evolution determining the course of mental development in the lower animals and in man. Preparation required: 3 and 4. First and second terms. (2)

6. Experimental Psychology. Laboratory work on experimental problems selected in part to illustrate and supplement course 5 and in part to meet the special needs of advanced students. Preparation required: 3 and 4. First and second terms. (1) or (2)

7. Pedagogy. The psychological basis of modern educational theory and practice. Intended to supplement courses 3 and 4. Elective for students who are taking or have had these courses. First and second terms. (1)

8. History of Education. A brief history of educational institutions and theories, with special reference to their origin and derivation in connection with the development of philosophic systems and ideals of culture. Intended to supplement courses 1 and 2, but may be elected independently. First and second terms. (1)

ECONOMICS AND PUBLIC LAW.

PROFESSOR STEWART.

10. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term. Required of students in School of General Literature (2), and of students in School of Technology. (1)

11. Economics. Practical economic problems: taxation, transportation, finance, labor, trusts and monopolies. Second term. Required of students in School of General Literature (2), and of students in School of Technology. (1)

12. Economics. Finance. Discussion of public expenditures; their nature, their relation to the industrial, political, and social conditions; their relation to the functions of government; also discussion of financial organization and administration. First term. (2)

13. Economics. Finance. Discussion of public revenues; of revenue derived from the public domain and public industries; the apportionment, classification, and administration of taxes; the nature and employment of public credit; the origin and growth of public debts. Second term. (2)

14. Public Law. Constitutional Law. Studies in Federal and State constitutional law. Preparation required: 23, 24, 25. First term. (2)

15. Public Law. Comparative Constitutional Law. Studies of the English, German and French governmental organizations. Second term. (2)

16. Public Law. International Law. Its origin and sources; its authority and sanction; state sovereignty; territorial rights of sovereignty; naval or maritime belligerency; the Declaration of Paris. First term. (2)

17. Public Law. International Law. The mitigation of war; the modern laws of war; rules as to prisoners and quarter; relations of belligerents on land; rights of capture by land; proposals to abolish war. Second term. (2)

HISTORY.

PROFESSOR RINGER.

20. European History. Political History of Europe from Congress of Vienna, 1815, to Congress of Berlin, 1878. First and second terms. (1)

PROFESSOR STEWART.

23. History. Europe and America in the 16th and 17th centuries. Growth of the British colonial interests. The War for American Independence. Physiography, 257, is to be elected with this course. Second term. (2)

24. HISTORY. Formation of the Federal Constitution. Development of political parties. Economic progress of the country previous to 1860. The struggle over secession. First term. (2)

25. HISTORY. The United States since 1865. Effects of the war upon the economic and social life of the Union. The industrial expansion and its relation to political organization. Second term. (2)

LANGUAGES.

LATIN.

PROFESSOR BLAKE.

30. LIVY. Selections from Books I, XXI, and XXII. CICERO, De Senecute, and De Amicitia. Particular attention to forms and the usages of normal syntax. Writing of Latin prose exercises based upon the selections read. Written translations from Latin into English. History of the struggle between Rome and Carthage. First term. (4)

31. HORACE. Odes and Epodes. CATULLUS. Insistence upon tasteful translation. Constant practice in metrical reading. Memorizing of some of the odes of Horace. Writing of brief original dissertations on topics assigned in connection with Horace. Historical review of Roman lyric and elegiac poetry. Second term. (4)

32. PLINY. Selected letters. TACITUS. Agricola and Germania. Latin prose composition based upon epistolary models. Consideration of social and legal usages suggested by Pliny. Some study of Roman provincial administration. First term. (3)

33. PLAUTUS AND TERENCE. Careful study of a play of each, with rapid reading of as much more as the time permits. Study of dramatic verse-structure and practice in metrical reading. History of the drama at Rome. Second term. (3)

34. HORACE. Selected Satires and Epistles, and Ars Poetica. Consideration of the philosophy and literary art of Horace. Second term. (2)

35. TACITUS. Selections from the Histories and Annals. Some consideration of Tacitus as an historian and a literary artist. Sight-reading from SUETONIUS. First term. (3)

36. JUVENAL. Selected Satires. Selections from MARTIAL. Satire and epigram in Roman literature. Study of social conditions under the empire as evidenced by the writings of the

younger Pliny, Tacitus, Suetonius, Juvenal, and Martial. Writing of brief dissertations on assigned topics. Second term. (3)

37. Lucretius. Careful study of one book entire of De Rerum Natura, with reading of selections from the other books. Consideration of textual questions. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. First term. (3)

38. Roman Law. An elementary course. Selections from the Institutes of Justinian, or Gaius, are read and commented on. Brief survey of Roman constitutional history and the development and content of the body of Roman Law, in connection with Morey's outlines of Roman Law. Second term. (3)

GREEK.

PROFESSOR GOODWIN.

40. Xenophon. Oeconomicus or Hellenica. Review of the Grammar. Prose Composition. Sight-reading. Attic prose syntax is carefully studied, and special attention given to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. One hour a week is devoted to composition and a variety of practical exercises. First term. (4)

41. Herodotus. One book, with sight-reading. Grammar and Composition. Study of the forms and syntax of the Ionic Dialect. Practical exercises continued. Second term. (4)

42. Plato. Euthyphro and Apology, with other dialogues. Introduction to Greek Philosophy. Practical exercises, including composition, are given once in two weeks. First term. (3)

43. Euripides. Alcestis, Hippolytus, or Bacchae. Literary study of the drama. Poetical language, style, and conception. Metres. Composition. Second term. (3)

44. Thucydides. One book; or Demosthenes. Selected Orations. Second term. (2)

45. Sophocles. Oedipus Tyrannus, Antigone, or Philoctetes. Aeschylus. Agamemnon, or Prometheus Bound. Aristotle. Poetics. Literary study of the drama continued. Practice in metrical reading. Text-criticism. First term. (3)

46. Plato. Selected shorter dialogues. Plato as philosopher and literary artist. Second term. (3)

47. Aristophanes. Clouds, Frogs, or Birds. Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. First term. (3)

48. Lyric Poetry. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from Pindar, or Theocritus. Study of the development of poetry in Greece. Second term. (3)

49. Hellenistic Greek. New Testament. Selections from Lucian. To be substituted on occasion for 48. Second term. (3)

FRENCH.

PROFESSOR RINGER,

ASSISTANT PROFESSOR GAUSS, MR. PALMER, DR. RICHARDS.

Required Courses.

(Courses 60, 61, 62 and 63 are to be taken successively by students beginning French.)

60. Elementary French. Whitney's French Grammar. Kuhns's French Reader. First term. (2)

61. Elementary French, continued. Grammar and Reader. Dictation. Reading of short stories by different authors. Second term. (2)

62. French. More advanced work in the Grammar. François's Introductory French Prose Composition. Readings from Thiers's Histoire du Consulat et de l'Empire. Selections from Dumas and other modern authors. First term. (2)

63. French. Continuation of course 62. Composition. Victor Hugo's dramatic works; Lamartine's Histoire des Girondins; Lavisse's Histoire Générale. Second term. (2)

(Courses 64 and 65 are to be taken in Freshman year by students offering French for entrance.)

64. French. Brief review of the Grammar. Composition based on work in the Grammar. Reading of de Vigny's Le Cachet Rouge; About's Le Roi des Montagnes; George Sand's La Mare au Diable. Dictation. First term. (3)

65. French. Continuation of course 64. François's French Composition, Part II. Reading of more difficult selections from modern authors and from the French Classic Literature. Second term. (3)

(Courses 66 and 67 are for the Sophomore year of Latin-Scientific and Classical students who have completed courses 64 and 65.)

66. French. Original Compositions. Conversation. More detailed study of the French classic drama with literary interpre-

tation. Individual reports on subjects assigned. First term. (2)

67. FRENCH. Continuation of course 66. Lectures on French Literature based on Brunetière's Manuel de l'Histoire de la Littérature Française. Collateral reading. Second term. (2)

Elective Courses.

(Courses 68 and 69, 70 and 71 will be given in alternate years.)

68. FRENCH. Lectures on 16th century French literature. The Renaissance in France. The School of Villon; Clément Marot; Rabelais; Montaigne; Calvin; the Pléiade; lesser poets; Brantôme; satire and the beginnings of the French drama. Collateral reading and reports on subjects assigned. First term. (2)

69. FRENCH. Lectures on the literature of the 17th century. Malherbe and the beginnings of the Classical School. Corneille, Molière and Racine; l'Hôtel de Rambouillet; Boileau; La Fontaine; Madame de Sevigné and the lesser authors. Reports in French on subjects assigned. Second term. (2)

70. FRENCH. Lectures on the literature of the 18th century. The end of the Classical Period. The 18th century drama. Marivaux, Crébillon, Montesquieu, Voltaire, the Encyclopedists, Rousseau, and the lesser writers. Reports in French on assigned subjects. First term. (2)

71. FRENCH. Lectures in French on 19th century literature, based on Pelissier's Le Mouvement Littéraire au XIX Siècle. A comprehensive study of the various literary types and movements up to the present day. Second term. (2)

(Courses 72 and 73 are designed primarily for Graduate Students.)

72. FRENCH. Historical Grammar. Lectures on the origins of the Romance Languages. The stages in their development and the influences at work upon them. Darmstetter's Cours de Grammaire Historique de la Langue Française, with lectures on phonology and morphology, and illustrative reading in Old French. First term. (2)

73. FRENCH. Continuation of course 72. Old French language and literature. Readings from the Chanson de Roland (G. Paris). The Chansons de Gestes and the Romans d'Aventures. The various cycles and their heroes. The Roman de la Rose; Villon. Old French forms, the chronicles, mystères, farces and sotties, the Confréries Dramatiques, satires and shorter verse forms.

Bartsch's Chrestomathie de l'ancien français, VIII-XV Siécle. Second term. (2)

A course in French conversation is open to students of all classes. (1)

Students desiring to elect advanced courses in French must consult the head of the Department.

GERMAN.

PROFESSOR RINGER,

ASSISTANT PROFESSOR GAUSS, MR. PALMER, DR. RICHARDS.

Required Courses.

(Courses 74, 75, 76 and 77 are to be taken successively by students beginning German.)

74. ELEMENTARY GERMAN. Joynes-Meissner's German Grammar. Harris's German Reader. First term. (2)

75. ELEMENTARY GERMAN, continued. Composition based on work in the Grammar. Dictation. Reading of short stories by various modern authors. Second term. (2)

76. GERMAN. More advanced work in the Grammar. Easy composition. Reading of more difficult German prose. First term. (2)

77. GERMAN. Continuation of course 76. Composition and Dictation. Rapid reading of selections from German History, Freytag's Aus dem Jahrhundert des Grossen Krieges, and works of like difficulty. Second term. (2)

(Courses 78 and 79 are to be taken in Freshman year by students offering German for entrance.)

78. GERMAN. Brief review of Joynes-Meissner's German Grammar, von Jagemann's Prose Composition, reading of selections from Paul Heyse, Baumbach and Dahn. Dictation. First term. (3)

79. GERMAN. Continuation of course 78. Advanced composition. Writing of original compositions on assigned subjects. Reading of such works as Freytag's Aus dem Staat Friedrichs des Grossen, and some of the master-pieces of Lessing, Schiller, or Goethe. Second term. (3)

(Courses 80 and 81 are for the Sophomore year of Latin-Scientific and Classical students who have completed courses 78 and 79.)

80. GERMAN. Original Compositions. Conversation. More detailed study of the 18th century German Classics with literary

interpretation. Individual reports on assigned subjects. First term. (2)

81. GERMAN. Continuation of course 80. Lectures on German literature based on Scherer's Geschichte der Deutschen Literatur. Collateral reading. Second term. (2)

Elective Courses.

(Courses 82 and 83, 84 and 85 will be given in alternate years.)

82. GERMAN. Lectures on German literature in the 16th and 17th centuries. Humanism and the Reformation. Hutten, Luther, Hans Sachs, Johann Fischart. The beginnings of the Drama. Andreas Gryphius, Christian Weise. The dawn of Modern Literature. Martin Opitz. Collateral reading and reports in German on subjects assigned. First term. (2)

83. GERMAN. Lectures on Klopstock, Lessing, Herder, Schiller, Goethe and other authors of the Classic Period. Second term. (2)

84. GERMAN. The German Romantic School. Novalis, Tieck, Wilhelm and Friedrich Schlegel, Fouqué, Arnim and Brentano, Heinrich von Kleist. Lectur s and collateral reading. First term. (2)

85. GERMAN. Lectures in German on 19th Century Literature. Second term. (2)

(Courses 86 and 87 are designed primarily for Graduate Students.)

86. GERMAN. Middle High German. Wright's Middle High German Primer. Bachmann's Mittelhochdeutsches Lesebuch. First term. (2)

87. GERMAN. Middle High German. Continuation of course 86. Nibelungenlied, Der Arme Heinrich, Wolfram's Parzifal, Walther von der Vogelweide. Lectures on the general character of the literature of the period. Second term. (2)

A course in German conversation is open to students of all classes. (1)

Students desiring to elect advanced courses in German must consult the head of the Department.

SPANISH.

ASSISTANT PROFESSOR GAUSS.

88a. ELEMENTARY SPANISH. Marion y Des Garennes Introduccion à la Lengua Castellana. Reading of easy modern Spanish. Dictations. Drill in Spanish conversation. First term. (2)

88b. Elementary Spanish, Continued. Continuation of course 88a. Reading of more difficult Spanish. Writing of short themes and practice in talking Spanish. Second term. (2)

The courses in Spanish are open to all students of the University, but cannot be accepted as the equivalent of French or German.

ITALIAN.

ASSISTANT PROFESSOR GAUSS.

89a. Italian. A brief study of Grandgent's Italian Grammar. Drill in writing exercises and use of elementary Italian. Reading of easy texts, stories of D'Amicis and comedies of Goldoni. Second term. (3)

89b. Italian. Continuation of course 89a. Reading of modern Italian authors, D'Annunzio, Verga, Serao, with selections from Ariosto or Tasso. Lectures on the Italian literature of the Renaissance. First term. (2)

89c. Italian. Study of Dante's Vita Nuova. Assigned readings in Dante, Petrarch, and Boccaccio. Reports by class on subjects assigned. Lectures on the origin of the Italian language and literature. First term. (1)

89d. Italian. The Divina Commedia of Dante. Detailed study of Dante, his poem and his time. Readings of Fraticelli's or Scartazzini's Edition of La Divina Commedia, with critical explanations and lectures. Second term. (2)

Courses 60 and 61 in French, or equivalent, must precede course 89a in Italian. Courses 89a and 89d are given in alternate years.

ENGLISH.

PROF. THAYER,

ASSISTANT PROFESSOR WHITMAN, DR. THOMPSON, MR. LUCH.

90. Rhetoric. A composition course based on Genung's Working Principles of Rhetoric, involving recitations and weekly themes on assigned subjects. First term. (2)

91. American Literature. Lectures on the basis of Trent's History of American Literature. Text-book to be read by the student in sections as assigned. The examination is based upon the text-book and the student's note-book. First term. (1)

92. History of the English Language. Lectures and classroom work, with the use of Lounsbury's History of the English Language as a text-book, supplemented by Emerson's and Champneys's. Second term. (2)

93. English Literature. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Simond's English Literature. First term. (2)

94. Literary Criticism. The subject varies annually between topics taken from Elizabethan Literature, lyric or dramatic, and from XIX Century Literature, earlier or later period. Second term. (2)

95. Essays, on subjects annually assigned, taken from American authors and requiring the previous reading of some specific work. Six essays a year meet this requirement.

96. Essays, on subjects based on English Literature. Six essays a year meet this requirement.

97. English Literature of the 19th Century, the periods 1798-1830 and 1830-1900 being given in alternate years. A lecture course based on Saintsbury's XIXth Century Literature. First term. (1)

98. Oratory. A formal course based upon Baker's Principles of Argumentation and Baker's Specimens of Argumentation, with recitations and the writing of Briefs. First term. (1)

99. Anglo-Saxon. Sweet's Anglo-Saxon Primer and Reader, with lectures on early English Literature, and readings from Brooke and Earle. First term. (3)

100. English Philology. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue previous to the Age of Chaucer. Preparation required: 99. Second term. (3)

101. Middle English. A critical study of the English of Chaucer, Langland, Wiclif, and Gower; followed by the literary study of selected specimens of their works. As text-books, The Student's Chaucer (Clarendon Press), Skeat's edition of The Vision of Piers the Plowman, Wiclif's translation of the New Testament revised by Purvey, and Gower's Confessio Amantis are assigned. First term. (3)

102. Poetics. A course based on Gummere's Handbook of Poetics, Alden's English Verse, Saintbury's Loci Critici, and the

use of Palgrave's Golden Treasury, The Oxford Book of English Verse, and Cook's The Art of Poetry, with practical exercises in verse-composition. Second term. (3)

103. To Seniors who wish to carry their linguistic work a little further, into the field of Teutonic philology, a course, alternative with 102, is offered, based upon Wright's Gothic Primer and Sweet's Icelandic Primer. Preparation required: 99 and 100. Second term. (3)

104. Extra courses on the Rise and Development of the English Novel and on the English Poets of the 19th Century (1830-1900) are offered in alternate years. These are both lecture courses, with private reading assigned; and, if supplemented by a rigid examination, will be taken as equivalent to one term's work in any class above the grade of Freshman.

PUBLLIC SPEAKING.

MR. EMERY.

108. PUBLIC SPEAKING. Declamations, discussion of current affairs, debates. Second term. (1)

109. PUBLIC SPEAKING. Original orations on topics of general interest, and discussion of engineering problems by technical students. First term. (1)

MATHEMATICS AND ASTRONOMY.

PROFESSOR THORNBURG,

ASSISTANT PROFESSOR MEAKER, ASSISTANT PROFESSOR LAMBERT, MR. OGBURN, DR. MILLER, MR. STOCKER.

110. SOLID GEOMETRY, beginning with Book VII and completing the subject. First term. (2)

111. TRIGONOMETRY. Plane Trigonometry, including mensuration and use of logarithmic tables. Preparation required: 110. First term. (2)

112. ELEMENTARY MECHANICS. Statics and dynamics with solutions of numerous illustrative and practical problems. First term. (4)

113. TRIGONOMETRY. Spherical Trigonometry, including mensuration and use of logarithmic tables. Second term. (1)

114. ADVANCED ALGEBRA, beginning with theory of quadratic equations and completing the subject. Second term. (4)

115. Analytic Geometry. Graphic representation of loci on cross-section paper, plane and solid analytic geometry. Preparation required: 111 or 114. First term. (5)

116. Differential and Integral Calculus. Embracing applications to analytical geometry problems, theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 115. Second term. (5)

117. Analytical Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 116. First term. (2)

118. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. Preparation required: 116 or 115 and 300. Second term. (3)

119. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude, and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 116, 118. First term. (3)

FREEHAND DRAWING.

MR. GELHAAR.

125. Freehand Drawing, with special reference to architecture, construction and machine parts. First term. (2)

CIVIL ENGINEERING.

PROFESSOR MERRIMAN,
ASSISTANT PROFESSOR WILSON, MR. RICE, MR. THAYER,
MR. TURRILL, MR. GAY.

131. Descriptive Geometry. The use of instruments. Tracing and lettering. The descriptive geometry of projections, intersections, and developments. Plans, elevations and sections of simple structural details. Preparation required: 125. Second term. (3)

132. Stereotomy. Problems in stone cutting, including plans for piers, culverts, and arches. Isometric drawings and linear perspective. Preparation required: 131. First term. (4)

133. Land Surveying. The theory and computation of areas, dividing land, and determining heights and distances. Map drawing and topographic signs. Field work with the level and transit in the determination of heights and distances, and in making surveys of farms. Map drawing from the students' field notes. Preparation required: 113, 131. Second term. (4); also in Summer term, four weeks, beginning June 15, 1905.

134. Topographic Surveying. The theory and use of the plane table, and of the transit and stadia. Pen topography. Detailed field work in rough country, and the construction of topographic contour maps. Leveling and triangulation. The adjustment of instruments with the investigation of their systematic errors. Preparation required: 133. Summer term, four weeks, beginning June 15, 1905.

135. Railroad Surveying. Reconnaissance, preliminary and location methods, with the theory of curves and turnouts. Location of a line, with the preparation of profiles and maps. The computation of earthwork and estimates of cost. Preparation required: 131, 133. Second term. (5)

136. Geodetic Surveying. Elements of the method of least squares and the application to the adjustment of triangulations. The figure of the earth. Field work in triangulation and in the determination of azimuth. Preparation required: 116, 118, 134. First term. (3)

137. Construction. Lectures on timber, stone, mortar, and concrete and on their use in structures. The construction of roads, streets, and pavements with the methods for their drainage and repair. Lectures on the history of engineering. Preparation required: 125, 131. First term. (2)

138. Construction. Lectures on foundations with piles, cribs, coffer dams, and caissons. Lectures on river and harbor improvements, on tunnels and canals, and on engineering work in progress of construction. Preparation required: 137. Second term. (2)

139. Railroads. The construction of the roadbed; including ballast, crossties, rails, switches, culverts, and other details. Maintenance of way, and the elements of railroad operation. Visits of inspection, with written reports. Preparation required: 133, 138. First term. (2)

140. Cement Testing. Lectures on the manufacture, properties, and testing of hydraulic cements and mortars. Each student makes all the standard tests in the cement laboratory. Preparation required: 360. First term. (1)

141. Dams and Arches. The theory and design of masonry walls, dams, and arches. Concrete steel beams and arches. Preparation required: 142. First term. (2) Not given in 1904-05.

142. Strength of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Each student makes fourteen experiments in the testing laboratory, which is equipped with 20,000, 100,000 and 150,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion and other apparatus for special work. Preparation required: 112, 116. A fee of $1 is required for the laboratory work. First term. (4)

143. Steel Buildings. Design of roof trusses and three-hinged arches. Mill building construction. Preparation required: 146. Second term. (2)

144. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. Preparation required: 112, 131. First term. (2)

145. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to simple cases. Analysis of stresses in bridge trusses under dead loads. Retaining walls and masonry arches. Preparation required: 112, 131. First term. (5)

146. Roofs and Bridges. The theory and computation of stress in roof and bridge trusses under dead, live and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 142. Second term. (3)

147. Bridge Design. The design of bridge floors and trusses. Sketches of details of bridges in the vicinity. Computations and working drawings are made from specifications for a railroad bridge of short span, and estimates of its weight are prepared. Preparation required: 146. First term. (5)

148. Bridges. Higher structures, including continuous, draw, cantilever, and suspension bridges, also metallic arches. Meth-

ods of analysis for statically indeterminate structures. Preparation required: 146. Second term. (2)

149. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. Preparation required: 112, 116. Second term. (3)

150. Sanitary Engineering. Systems of water supply, including purification systems, reservoirs, pipe lines, and pumping plants. Preparation required: 139, 149. First term. (2)

151. Sanitary Engineering. Systems of sewerage and methods of sewer purification. House drainage. Preparation required: 150. Second term. (2)

152. Engineering Inspection. During the vacation between the Junior and Senior years each student in civil engineering is required to inspect some engineering work and prepare a report thereon. A brief description of the work or structure that the student desires to inspect must be presented to the Professor of Civil Engineering before July 15, and after approval, the report thereon must be submitted before September 15. These reports will contain such drawings and computations as each case may demand, and their length will usually be from twenty to thirty pages of letter paper.

153. Thesis for Degree of C.E. Candidates for the degree of Civil Engineer select the subjects of their theses in the first term of the Senior year. Advice is given in regard to the plan of work, and references to literature are indicated. Reports concerning the progress of the investigation are made at intervals during the second term. The thesis is regarded as a part of the final examinations of the course.

SUMMER SCHOOLS IN CIVIL ENGINEERING.

Surveying. Exercises in Land Surveying and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the Summer vacation. In 1905 this work begins at 8 A. M. on June 15 and ends on July 8.

The work in Land Surveying is described under No. 133, on page 51. Students in Mining Engineering and Geology are required to take this work at the close of the Freshman year. The fee for other persons is $20.

The work in Topographic Surveying is described under No. 134, on page 51. Students in Civil and Mining Engineering and Geology are required to take this subject at the close of the Sophomore year. The fee for other persons is $20.

Strength of Materials. Twenty-four exercises in the class-room and six in the testing laboratory will be given in 1905, beginning at 9 A.M. on August 18 and ending on September 15. As this work is a rapid review of the subject described under No. 142, it can be taken only by those who study during July and August under instructions which must be obtained from the Professor of Civil Engineering prior to June 14, 1905. The fee is $25.

Hydraulics. Twenty-two exercises in the class-room will be given in 1905, beginning at 11 A.M. on August 21 and ending on September 14. As this work is a rapid review of the subject described under No. 149, it can be taken only by those who study during July and August under instructions which must be obtained from the Professor of Civil Engineering prior to June 14, 1905. The fee is $20.

Inspection Report. Inspection of engineering work and a report thereon is required of all students in civil engineering during the vacation following the junior year. This is described under No. 152, on page 53.

MECHANICAL ENGINEERING.

PROFESSOR KLEIN,

ASSISTANT PROFESSOR HECK,

DR. LOEWENSTEIN, MR. KLEIN, MR. EASTWOOD.

170. Drawing and Elements of Machine Design. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. Second term. (3)

171. Constructive Elements of Machinery. Visits of inspection. Examination and sketching of machine parts and machinery. A classified and numbered list of some three hundred and sixty items is given to each student, who makes a written report on them with freehand sketches containing the leading dimensions. The class is divided into sections, which are sepa-

rately taken into the shops by the instructor, who then indicates the pieces that are to be examined and gives all necessary explanations. In addition a score of machines of all sorts are taken apart and again put together by this class. This work is accompanied by Constructive Elements of Electrical Apparatus, No. 330. For further details see special circulars of the M.E. and E.E. departments. Summer term, four weeks, beginning June 15, 1905.

172. Elements of Machine Design. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers, and connecting rods. First term. (3)

173. Boilers. Description of various types, and of details of construction, staying, setting, etc.; strength of the structure; accessories; fuels and furnaces; operation; wear and tear; visits of inspection to a boiler shop and to a boiler plant. Text-book: Peabody and Miller. First term. (1)

174. Steam Engine. Elementary Thermodynamics, theory of the ideal heat engine, properties of steam and efficiency of the steam engine. Mechanics of the engine, steam pressures, inertia resistances, turning force diagrams, etc. Valve gears, valve diagrams applied to slide valves, shaft governors, and link motion. The steam engine indicator and study of diagrams. Outline of the study of economy, compounding, etc. The descriptive work is supplemented by shop visits. The solution of many graphical and numerical problems is required. Text-book: Holmes's Steam Engine. Second term. (4)

175. Steam Engine. Shorter course. Second term. (3)

176. Mechanical Technology. Each student is required to give a full written description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings, and finished pieces, which are under construction in the shops at the time and drawings for which have been given to him on entering the shops. The student's work is personally directed by an instructor, who accompanies him in each shop, gives necessary explanations, and tests the extent and accuracy of his knowledge. Four teachers are engaged in this work, one for each shop and section. Summer term, four weeks, beginning June 15, 1905.

177. Mechanics of Machinery. Graphical statics of mechanisms. Determination of the efficiency of a machine and of the

forces acting in every one of its pieces and parts. All the problems are given to the students in the form of black prints and consist of a series of suitably graded examples of machinery. In these both frictional and inertia resistances are considered. First term. (2)

178. Engineering Laboratory. Use and calibration of apparatus for measuring weight, volume, pressure, temperature, speed, etc., for engineering purposes. First term. (2)

179. Engineering Laboratory. Work of 178 continued. Indicator practice, on engines in the laboratory and in factories and power plants in the neighborhood; complete working up of indicator diagrams from simple and compound engines, air compressors, etc. Second term. (1)

180. Graphic Dynamics of a High-Speed Engine. Complete force analysis, first by approximate practical methods and then by methods theoretically exact; action of steam forces, inertia resistances, etc. Preliminary design, consisting of a determination of the most important dimensions for an engine which is to work under given conditions. Second term. (3)

181. Mechanics of Machinery. Machinery of Transmission. Weisbach-Hermann series: Vol. III, Part I, Section I. This treats of the Mechanics of Machine Parts and determines their dimensions from considerations of strength and durability. The Introduction is also studied for its excellent analytical presentation of the subject of acceleration. Second term. (3)

182. Summer School in Engineering Laboratory. Simple tests with steam—steam calorimeters, injectors, flow of steam, performance of steam-traps, etc.; tests of small steam pumps, of a steam turbine, of engine performance; of hot-air and gas engines, and of an air compressor. Boiler management and testing. Dynamometer work, belt testing, friction and lubrication. Summer term, four weeks, beginning June 15, 1905.

186. Thermodynamics. Proof of the fundamental laws; equations of condition for air and superheated steam; the relations between pressure, volume, temperature, work and heat for special changes of state. Establishment of the fundamental equations of thermodynamics and their adaptation to gases and vapors. Application of the results and of graphical methods to technical problems. First term. (3)

187. Kinematics of Machinery. This treats of the constrained motion peculiar to machinery and of the nature and equivalence

of mechanisms. As here pursued it consists of a few lectures accompanied by a large amount of work in the drafting room. This work is mainly expended on the construction of centrodes, on inversions and skeletons of mechanisms and also on the preparation of displacement, velocity and acceleration diagrams for a great variety of machines. This is followed by much practice in mass and force reductions, the latter including many forms of inertia resistance and external forces. First term. (4)

188. Design of Special Machinery. Each student is required to design some example of metal working machinery, as a lathe, plane, drill, or milling machine, so as to gain experience in proportioning parts both for strength and stiffness. This design is followed by one for a still more special machine, say, for performing some unusual operation. First term. (5)

189. Design of Special Machinery. Shorter course. First term. (2)

190. Engineering Laboratory. Work of 179 and 182 continued. Tests of boilers, of power plants and of pumping stations in the neighborhood. Advanced work along the lines of 182. First term. (1)

191. Engineering Laboratory. A shorter course, selected and condensed from 178 to 198 especially in steam engineering, for students in Marine, Metallurgical, Mining, and Electrical Engineering, and Electrometallurgy. First term. (1)

192. Engineering Laboratory. Work of 191 completed, along same lines. Second term. (1)

193. Mechanics of Machinery. Cranes, Excavators and Pile Drivers. Chapters VI to VIII, inclusive, of Weisbach-Herrmann's Mechanics of Hoisting Machinery. These recitations are supplemented by visits of inspection. The Locomotive. The descriptive portion of the work is illustrated by drawings from good current practice and includes visits to the L. V. R. R. Repair Shop at South Easton. The mechanics of the locomotive is taken up as fully as time will permit; the subjects touched on are: General proportions, detailed analysis of the forces and inertia resistances, valve gear action, performance of the running gear on curves, etc. Extensive use is made of diagrams showing the fluctuations of the various periodic forces throughout a revolution. First term. (2)

194. Design of Special Machinery. This work is mainly a continuation of course 188. To complete this course there is required an original design for a hoist, or hydraulic press, or an automatic machine used for manufacturing some such article as wire nails. Second term. (6) or (5)

196. Engineering Laboratory. Analysis of flue gases; complete tests of the power plants of the vicinity. Second term. (1)

197. Mechanics of Machinery. Hoists, Pumps, Compressors, Blowing Engines, and Fans. The presentation is that of the Weisbach-Herrman series. The class-room work is supplemented by suitably timed visits of inspection. Second term. (4)

198. Engineering Laboratory. Work of 190 carried forward, along same lines. Second term. (1)

199. Steam Turbines. The Mechanics, Thermodynamics, and Construction of the Steam Turbine. Text-book: Stodola. Second term. (4)

200. Ship Calculations and Yacht Design. Laying down and fairing lines, calculation of displacement and metacentric sheets; curves of areas, block coefficients, etc.; stability, Barnes's method and method of cross curves, curves of stability, dynamical stability; surface of buoyancy, surface of waterlines; resistance and propulsion of ships. Text-books: Atwood's Theoretical Naval Architecture, Peabody's Notes on Naval Architecture. Second term. (5)

201. Ship Drawing and Design. Dimensions of ship to suit given condition, and designing of liner, construction of steel ships, classification rules, specifications, strength of ships, theory of waves, rolling of ships, resistance and propulsion of ships. Text-book: Peabody's Notes on Naval Architecture. First term. (5)

202. Marine Boilers. Description of the best modern types of water tube and fire tube boilers, their arrangements, details, proportions and design. Arrangement of machinery in ship. Text-book: Bertin & Robertson's Marine Boilers. First term. (1)

203. Ship Design. Powering of ships, and screw propellers, effect of movement and addition of weights, grounding or bilging; special types of vessels; strength of bulkheads; launching; steering and maneuvering; careening, docks and docking, sails and sailing, methods of calculating weights and vibrations. Text-

books: Peabody's Notes on Naval Architecture, Thomas Walton's Steel Ships, their Construction and Maintenance. Second term. (5)

204. Marine Engines. Advanced study of the multiple cylinder engine, economy, determination of best expansion ratios, arrangement of cylinders, discussion of the strength and proportion of moving parts, marine engine valve gears, equalization of work on several cranks, vibration and balancing of moving parts. Text-book: Bauer's Calculation and Construction of Marine Engines and Boilers. Reference books: Busley's The Marine Steam Engine, Seaton & Rounthwaite's Marine Engineer's Pocketbook, Sennett & Oram's The Marine Steam Engine. Second term. (2)

205. Summer School in Marine Engineering. Constructive elements of ships. Visits of inspection and of observation to the ships, shops, and yards of ship building establishments. Summer term, four weeks, beginning June 15, 1905.

210. Thesis for Degree of M.E. Candidates for the degree of Mechanical Engineer are required to present theses upon topics connected with mechanical or marine engineering. Drawings and diagrams are required whenever the subjects discussed need such illustration.

For Summer Schools see courses 171 (connected with course 330), 176, 182, and 205, also statement on page 78.

IN MINERALOGY.

PROFESSOR FRAZIER, PROFESSOR RICHARDS, MR. LANDIS, MR. HENDRICKS.

220. Crystallography. Elementary course in Geometric Crystallography, with practical exercises in the determination of crystalline forms in models and actual crystals. First term. (2)

221. Mineralogy. Elementary course in physical, chemical, and descriptive Mineralogy, with practical exercises in the determination of about two hundred of the more common mineral species. Text-book: E. S. Dana's Text-book of Mineralogy. Second term. (3)

222. Mineralogy. Shorter course. Second term. (2)

(A deposit of $5 is required from each student taking courses 220, 221, and 222, to cover damage to collections and instruments and the value of supplies furnished him. In case the damage consists only of ordinary wear and tear the amount retained to cover it will not exceed $2 for each student.)

223. Blowpipe Analysis. An elementary course in blowpipe analysis considered as a method of qualitative chemical analysis. Illustrated lectures followed by practical testing for thirty-five bases and fifteen acids. Reference book: Plattner's Blowpipe Analysis, Latest English Edition (1902). Second term. (1)

224. Blowpipe Analysis. Advanced blowpipe tests and separations. The application of blowpipe methods as primary tests for determining minerals. Text-book: Plattner's Löthrohrprobirkunde. Sixth German edition, revised by Dr. F. Kolbeck, or latest English translation. First term. (1)

225. Blowpipe Analysis. Laboratory work in quantitative blowpipe analysis, dealing particularly with the determination of gold, silver, cobalt, nickel, copper, lead, tin, bismuth, mercury, and analysis of coal. Reference book: Plattner's Löthrohrprobirkunde. First term. (1)

(In each of the Blowpipe courses a deposit of $2 is required, of which, on an average, $1 is retained to cover cost of gas, chemicals, and specimens supplied.)

IN METALLURGY.

PROFESSOR RICHARDS, MR. SULLIVAN, MR. LANDIS, MR. HENDRICKS.

230. Drawing and Metallurgical Construction. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches. General views from given details. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., accompanying the study of descriptive geometry and illustrated from examples of mining and metallurgical plant. Flat tinting with water colors. First term. (4)

231. Metallurgical Construction and Drawing. Examination and sketching of metallurgical plant in the vicinity. General views and working drawings of the plant examined, accompanied by written descriptions of its construction and operation. Second term. (3) For students in Course of Mining Engineering, First term. (3)

232. Metallurgical Design. Execution of designs accompanied by working drawings and estimates of material and cost for the erection of metallurgical plant under given conditions. Second term. (2)

233. General Metallurgy and the Metallurgy of Iron. General Metallurgy. Metallurgical processes. Transmission of heat. Measurement of high temperatures. Furnaces. Fluxing. Fireproof materials. Principles of thermal chemistry. Combustion. Properties of natural and artificial fuels. Manufacture of gaseous fuels. The Siemens Furnace. Charcoal burning. Coking. The electric furnace. Reference books: Schnabel's Allgemeine Huttenkunde, Roberts-Austen's Introduction to the Study of Metallurgy.

Metallurgy of Iron: Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. Remelting in the foundry. Pig washing. Puddling. The Bessemer process. The open hearth process. Cementation. Manufacture of crucible steel. Direct processes. Methods of casting and forging. Reference books: Ledebur's Eisenhüttenkunde, Bauerman's Metallurgy of Iron. Second term. (5)

234. General Metallurgy and the Metallurgy of Iron. Shorter course. Reference book: Phillips-Bauerman's Elements of Metallurgy. Second term. (3)

235. Metallurgy of Copper, Lead, Silver, Gold, Zinc, Mercury, and Aluminium. Copper: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet processes. Electrolytic processes. Lead: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. Silver: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. Gold: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Zinc: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. Mercury: Chemical and physical properties. Ores. Processes of extraction. Aluminium: Chemical and physical properties. Ores. Extraction by electrolysis. Reference book: Schnabel's Handbook of Metallurgy. First term. (4)

236. Metallurgical Laboratory. Calibration and use of pyrometers and calorimeters. Determination of melting and freezing points of metals and other metallurgical products. Study

of cooling curves. Deposit, $10. Reference book: Howe's Metallurgical Laboratory Notes. Second term. (1)

237. Theory of Electrolysis. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions, and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference book: Lüpke's Elements of Electro-Chemistry. First term. (1)

238. Electrometallurgy. Lectures discussing the practical applications of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's Electrometallurgie, Blount's Practical Electrochemistry. Second term. (1)

239. Electrometallurgical Laboratory. Quantitative separations and depositions of metals by electrolysis. Experimental determination of the conditions controlling the nature of electrolytic deposits. Electrolysis of salts. Deposit, $10. First and second terms. (1)

(Extra courses in the reading of Technical German, French, and Spanish are offered during the second term by the staff of this Department.)

240. Thesis for the Degree of Met. E. Every student in Metallurgical Engineering is required to present a thesis on some topic connected with this subject.

241. Thesis for the Degree of El. Met. The thesis required for this degree will be upon some subject connected with the theory or practice of Electrometallurgy.

For Summer Schools see courses 171, 330, and 176, also statement on page 78.

GEOLOGY.

ASSISTANT PROFESSOR IRVING, MR. BROWN.

250. Geology. Short course. A course in structural and dynamic Geology, including the subject of Lithology or the study of rocks without the microscope. Recitations and lectures illustrated by lantern views. Five field trips are given in connection with the work. This course is especially designed for students of civil engineering whose work is not concerned primarily with geology and who do not expect to prepare themselves for the courses in applied geology which follow. It is also recommended to students in the School of General Literature. First term. (2)

251. GEOLOGY. Short course. A continuation of 250. Historical Geology. The classification of geologic time. Study of the types of life characteristic of the different periods, and the principles of organic evolution which they illustrate; a brief review of the geology of the United States and the physical changes which the country has undergone during its development. Five field trips are held as in the first term. Second term. (2)

252. GEOLOGY. Long course. Structural and dynamic Geology including a thorough grounding in the study of rocks without the microscope. Lectures illustrated by lantern views; recitations. Essays on geological subjects are assigned to the men from time to time and five field trips are held in conjunction with the work. Each student is required to take detailed field notes on the geology of the region. This course is designed for those men who will pursue the technical courses in applied geology which follow in the Senior year. Preparation required 220, 221. First term. (3)

253. GEOLOGY. Long course. A continuation of 252. Historical Geology. The classification of geologic time. Study of the types of life characteristic of the different periods and the principles of organic evolution which they illustrate with a brief review of the geology of the United States and the physical changes which the country has undergone during its development. Five field trips are held in conjunction with the work, as in the first term. Preparation required: 252. Second term. (2)

254. ECONOMIC GEOLOGY. Causes of the formation of cavities in rocks, their relation to metalliferous deposits; discussion of the theories of ore-deposition; the structure, geological horizon and geographic distribution of the principal metallic and non-metallic economic deposits of the United States. Recitations, illustrated lectures and laboratory work. Each student is required to prepare a series of plates illustrating the location, production, chemistry and geology of the economic products of the United States. Preparation required: 250 and 251 or 252 and 253. Second term. (3)

255. GEOLOGY. Invertebrate and vertebrate palaeontology. Text-book and laboratory work in describing and identifying fossils. Preparation required: 251 or 253. First term. (4)

256. GEOLOGY OF THE UNITED STATES. The physiographic provinces of the United States, their development and relation to one another; the geological age and geographical distribution

of the rocks of which the United States is composed; the structure and history of its mountain ranges, the formation of its great lakes and drainage systems; the history of its geological development and origin; reviews of the great surveys that have been made and their history. Lectures and laboratory work. Preparation required: 250 and 251, or 252 and 253. Second term. (3)

257. Physiography. The cosmical relations of the earth; the classification of land forms; the study of their origin, growth and decay and the factors governing their development; their geographical distribution. The response of man and other organic life to an inorganic environment with special reference to the influence of Physiography upon the economic development of a country. Preparation required: 250 or 252. Second term. (3)

258. Field Geology. Elementary field geology to accompany 252. Preparation required: 221. First term. (3)

259. Field Geology. Field work to accompany 253. Preparation required: 252. Second term. (3)

260. Field Geology. Geological maps; their use and the methods by which they are constructed. Practice in the actual working out of surface geology. Problems in plotting geology on topographic maps; each student will be assigned a definite area and will be required to make a geological map of it with structure sections. He will also collect a full set of specimens to illustrate the geology. The first part of the course will be devoted exclusively to field work and the notes then taken will be worked up in the laboratory when the weather prevents further out-of-door work. Preparation required: 250 and 251 or 252 and 253. First term. (2)

261. Petrology. The optical properties of minerals and their study with the petrographical microscope. Recitations and laboratory work. Preparation required: 220, 221, 305, 306. First term. (2)

262. Petrology. The determination of rocks by means of the petrographical microscope. This course is designed to aid in the study of those species of rocks which are too difficult to determine with the unassisted eye and to lead to a clearer understanding of the fundamental principles of the origin and classification of rocks. Lectures, recitations and laboratory work.

Practice in preparation and mounting of thin sections. Preparation required: 261. Second term. (1)

263. PETROLOGY. Advanced course. The collection of a suite of rocks from some region, the preparation of thin sections and the completion of an illustrated paper embodying the results of the study. Second term. (2)

264. THESIS FOR THE DEGREE OF B. S. (GEOLOGY). Every student in this course who is a candidate for this degree is required to present a thesis on some topic connected with Geology.

For Summer Schools see courses 133 and 134, also statement on page 78.

BIOLOGY.

ASSISTANT PROFESSOR HALL.

270. BOTANY. An elementary course treating of the structure and classification of plants. Lectures, laboratory work, and references to text-books. Preparation advantageous: 272. Second term. (2)

271. PLANT BIOLOGY (ELEMENTS OF FORESTRY). Recitations and lectures on the morphology, physiology, adaptation to environment, and classification of plants, especially trees; embodying the hygiene of forest and shade trees and the characteristics of useful timber woods. Second term. (1)

272. BIOLOGY. Lectures, recitations, and laboratory work. The lectures discuss the following topics: (*a*) fundamental conceptions; life, protoplasm, the cell, etc.; (*b*) the structure, development, relationships, habits, and geographic distribution of animals; (*c*) the more important biological theories; variation, heredity, evolution, etc. First term. (3)

273. ZOÖLOGY. Lectures on the embryology and comparative anatomy of vertebrates, with a more extended discussion of biological theories. The major part of the laboratory work consists in tracing the embryonic development of vertebrates. By the study of living, preserved, and sectioned material, the successive stages of cleavage, gastrulation, and the formation of organs are demonstrated. Preparation required: 272. Second term. (3)

274. HISTOLOGY. Lectures, reading, and laboratory work on the structure, growth, and differentiation of tissues. Preparation required: 273. Second term. (2)

275. Sanitary Biology. Lectures, recitations, assigned reading and laboratory work. Study of bacteria; microscopical appearance, methods of staining, plate and tube cultures, etc. The quantitative and qualitative bacteriological and microscopical examination of water. Preparation advantageous: 270 or 272. Second term. (2)

276. Bacteriology. Recitations and laboratory work. After the general study of bacteria, special attention is paid, in this course, to those forms which are economically important, such as those of foods, dairy products, soils, etc. First term. (2)

(A deposit of $5.00 is required in each of the courses in biology, except course 271, to cover cost of material and breakage, which need not exceed $3.00).

DR. ESTES.

279. Hygiene. This is a course of didactic lectures supplemented by regular recitations and quizzes given to the Freshman class. The course is intended to teach the students at the very beginning of their college life some idea of the importance and the methods of personal hygiene and sanitary laws. It is also intended to suggest to young men who may become engineers, miners, and explorers the importance of and how to take proper measures for the sanitary comfort and personal well-being of men who may, in after life, be under their control and leadership. First term. (2)

MINING ENGINEERING.

PROFESSOR ECKFELDT, MR. SULLIVAN.

280. Prospecting. Modes of occurrence of minerals. Uses of Geology. Prospecting for placer, lode and bedded deposits. Magnetic prospecting. Preliminary boring. Sampling. Valuation of property. Location of claims. Patents to mining ground. Lectures and recitations. Preparation required: 250 or 252. Second term. (1)

281. Boring. Uses of bore holes. Methods: By rotation; by percussion with rods and ropes. Special methods: Shaft sinking by boring. Survey of bore holes. Lectures and recitations. Preparation required: 250 or 252. Second term. (1)

282. Mining. Location of plant; breaking ground; tools and machines. Explosives; laws; blasting. Shaft and slope sinking. Tunneling. Supporting excavations; timber, metal, masonry.

Development of deposits. Systems of mining underground and at the surface. Lectures and recitations. Preparation required: 250 or 252. Second term. (3)

283. TRANSPORTATION. HOISTING: Motors, ropes, and attachments. Receptacles. Safety appliances. Laws. Systems of hoisting. HAULAGE. Surface and underground. Motors, vehicles. Systems: Wire rope; aerial tramways. Loading and unloading; stocking and storage of minerals. Transportation of workmen. Signaling. Lectures and recitations. Preparation required: 112. First term. (1)

284. DRAINAGE. Surface water. Prevention of access. Dams. Drainage by tunnels. Mechanical drainage; hoisting water; pumping. Classes of pumps. Classes and positions of motors. Lectures and recitations. Preparation required: 112, 149. First term. (1)

285. VENTILATION AND LIGHTING. Atmosphere of mines. Pollution. Natural and artificial ventilation. Systems. Classes and efficiencies of ventilators. Testing air. Instruments. Laws. LIGHTING. Methods. Dangers. Laws. Safety-lamps. Lighting by electricty. Lectures and recitations. Preparation required: 300, 302, 305, 360. First term. (1)

286. ACCIDENTS. Classes. Causes. Means of prevention. Rescue. Hygiene of mines; rules and laws. First aid to injured. Lectures and recitations. Preparation required: 142 and all of preceding subjects. First term. (1)

287. MINE CONSTRUCTIONS. The use of stone, brick, cement, concrete, metal and timber with special reference to mining plant. Foundations, piling, dams, reservoirs, retaining walls, mine buildings, trestles, tipples, ore-bins and docks. Lectures and recitations. Preparation required: All of preceding subjects. First term. (1)

288. MINE ADMINISTRATION. Management, organization, employment of labor, mine accounts, etc. Lectures and recitations. Preparation required: All of preceding subjects. Second term. (1)

289. DRESSING. Theory of ore dressing. Physical principles involved. Machines used in wet, dry, and magnetic methods; order of arrangement. Processes. Location of works. Preparation of coal. Lectures and recitations. Preparation required: 221 or 222. First term. (3)

290. MINE SURVEYING AND MINE RAILROADS. Instruments. Forms of notes. Outside work. Determination of meridian. Inside

work. Connecting outside and inside work through shafts, slopes, or tunnels. Calculation of notes; mapping. RAILROAD SURVEYING: location of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. Preparation required: 133, 134. Summer term at the end of Junior year, four weeks, beginning June 15, 1905.

291. MECHANICAL DRAWING. Use of instruments. Lettering. Sketches and working drawings of machine parts. Tracings and blue prints. Isometric and orthographic projections. Intersections and developments of cylinders, cones, spheres, etc. First term. (3) Second term. (1)

292. MINING DESIGN. The design of parts of mining plant to meet given conditions, with detailed working drawings, accompanied by estimates of material and costs. Preparation required: 291, 142, 144, 177, and mining subjects. Second term. (4)

293. THESIS FOR DEGREE OF E.M. Candidates are required to present a thesis on some topic connected with this subject. With the approval of the Professor of Metallurgy or Geology a subject may be taken from some topic in those courses.

For Summer Schools see courses 133, 134, and 290, also statement on page 78.

PHYSICS.

PROFESSOR FRANKLIN,

MR. MACNUTT, MR. CRAWFORD, DR. WHITEHORNE.

300. ELEMENTARY PHYSICS. Mechanics and Heat. Lectures, recitations and problem work. Preparation required: 112. Second term. (2)

301. ELEMENTARY PHYSICAL LABORATORY, accompanying 300. Second term. (1)

302. ELEMENTARY PHYSICS. Electricity and Magnetism. Lectures, recitations, and problem work. Preparation required: 300, 301. First term. (3)

303. ELEMENTARY PHYSICS. Mechanics, Heat, Electricity, and Magnetism. Lectures, recitations, and problem work. This study is offered to students in the School of General Literature. Preparation required: 112 or 114. First term. (3)

304. ELEMENTARY PHYSICAL LABORATORY, accompanying 302 and 303. First term. (1)

305. Elementary Physics. Light and Sound. Lectures, recitations, and problem work. Preparation required: 302 or 303, and 304. Second term. (3)

306. Elementary Physical Laboratory, accompanying 305. Second term. (1)

307. Advanced Theory of Electricity and Magnetism. Electrical units, electrical measurements, inductance, the magnetism of iron, and electromagnetic theory. Lectures, recitations, and problem work. Preparation required: 116 and 300 to 306, inclusive. First term. (2)

308. Electrical Laboratory, accompanying 307. Precise electrical measurements. First term. (1)

309. Electrical Laboratory. Continuation of 308. Precise electrical measurements. In connection with this study a number of simple dynamo and motor tests and a few alternating current measurements are given in order to facilitate the class work in 333, 334, and 335. Second term. (1) For students in the Course in Physics: First term. (1)

310. Theory of Light. This study is based upon Preston's Theory of Light, supplemented by Drude's Lehrbuch der Optik and by the reading of monographs on optics. First term. (5)

311. Theory of Heat. This study is based upon Clausius's Theory of Heat, supplemented by the reading of monographs on Physical Chemistry. Second term. (4)

312. Physical Laboratory. This course in laboratory work, offered during the Senior year to students taking the Course in Physics, consists of refined measurements in any branch of Physics at the option of the student, and it leads to the thesis work of the following term. First term. (2)

313. Physical Seminary. The study of current literature in Physics. The membership of the Physical Seminary includes the corps of instructors of the department of Physics, together with Senior students in Physics. First and second terms. (2)

314. Electrical Laboratory, accompanying 237. Experimental studies in electrolysis. Measurements of resistances of electrolytes, applications of Faraday's laws of electrolysis, studies of electrolyte polarization, determinations of critical voltages of decomposition, tests of primary batteries and storage batteries, and tests of commercial types of electrolytic cells. First term. (1)

315. Theory of Alternating Currents. A general survey of the elementary theory of alternating currents. Lectures, recita-

tions, and problem work. Preparation required: 307, 308, 331 (or 332). Second term. (2)

316. Theory of Alternating Currents. Continuation of 315. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 315, 333. First term. (3)

317. Theory of Alternating Currents. Continuation of 316. Advanced theoretical studies of transformers, induction motors, and transmission lines. Preparation required: 316. Second term. (3)

318. Advanced Electrical Measurements. Precise measurements of capacity and inductance, electrolytic measurements, tests of dielectric strength of insulators and conductivity tests of wires. First term. (1)

319. Thesis for the Degree of B.S. (in Physics). Each candidate for the degree of B.S. (in Physics) is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory or experimental research.

Beginning with the second term, Freshman year, a deposit of $10 each term to cover breakage, wear and tear of apparatus, appliances, etc., in the departments of Physics or Electrical Engineering is required of each student. The unused balance of the deposit is returned to the student.

ELECTRICAL ENGINEERING.

PROFESSOR ESTY, MR. REGESTEIN, MR. SEYFERT.

330. Constructive Elements of Electrical Apparatus. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. The student is supplied with a complete printed outline of the work to be done containing full instructions and explanations. The work consists of three parts, as follows: (a) Illustrated lectures, (b) Inspection and sketching of electrical machines and apparatus, and (c) Visits of inspection to neighboring electric light and power plants. Written reports are required on each day's work. Deposit, $3. This

work is accompanied by Constructive Elements of Machinery, No. 171. Summer term, four weeks, beginning June 15, 1905.

331. Dynamos and Motors. Elementary electrodynamics with applications to direct current machinery. Principles of construction, operation, and characteristics of dynamo electric machinery with special reference to direct current types. Illustrative problems. Preparation required: 300 to 306, inclusive, and simultaneous work in 307 and 308. First term. (3)

332. Dynamos and Motors. This is an abbreviated course adapted to those students who do not continue this subject in the Senior year. Special attention is given to the operation, regulation, management, and methods of testing of dynamos and motors. Illustrative problems. Preparation required: 300 to 306, inclusive, and simultaneous work in 307 and 308. First term. (2)

315. Theory of Alternating Currents. Given in the department of Physics. A general survey of the elementary theory of alternating currents. Lectures, recitations, and problem work. Preparation required: 307, 308, 331, (or 332). Second term. (2)

333. Electrical Engineering. Continuation of 332. General survey of the more important industrial applications of electricity. Systems of generation, distribution, and transmission by direct and alternating currents; wiring; arc and incandescent lamps; feeder regulation. The latter part of the course is devoted to alternating current generators, motors, and transformers, being supplementary to the course in the Theory of Alternating Currents. Preparation required: 307, 331. Second term. (2)

334. Electrical Engineering. Continuation of 332. Similar in general scope to preceding. Particularly adapted to students who do not further specialize in the various technical applications above outlined. Preparation required: 307, 332. Second term. (2)

309. Electrical Laboratory. Given jointly by the departments of Physics and of Electrical Engineering. Continuation of 308. Precise electrical measurements. In connection with this study a number of simple dynamo and motor tests and a few alternating current measurements are given in order to facilitate the class work in 333, 334 and 335. Second term. (1)

316. Theory of Alternating Currents. Given in the department of Physics. Continuation of 315. Advanced theoretical

studies of alternators, synchronous motors, and synchronous converters. Preparation required: 315, 333. First term. (3)

335. Dynamo-Electric Machinery. Continuation of 331. Advanced study of dynamo and motor characteristics, theory of regulation, armature windings, armature reactions; study of alternating current machinery is begun; illustrative problems. Preparation required: 315, 333. First term. (3)

336. Alternating Current Machinery. Continuation of 335 and accompanying 317. Study of the structural details, characteristics and operation of alternators, alternating current motors, rotary converters, and transformers; illustrative problems. Preparation required: 316, 335. Second term. (1)

337. Electrical Design. Accompanying 335. Calculations of electromagnetic mechanisms and direct current dynamo-electric machinery; a graded series of problems leading up to original designing; drafting. Preparation required: 331, 333. First term. (2)

338. Electric Lighting and Power Stations. Systems of electric lighting; principles and economics of location of site; selection, arrangement, and sub-division of generating units; consideration of prime movers, generators, switch-boards, storage batteries and auxiliaries; general design of buildings and interior arrangements. Methods and economics of distribution of electrical energy for light and power by direct and alternating currents; regulation and operation of supply circuits; insurance rules and regulations; commercial photometry; visits of inspection to neighboring plants. Preparation required: 315, 333. First term. (2)

339. Electrical Engineering Seminary. A weekly meeting is held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; new inventions and discoveries critically reviewed. Preparation required: 315, 333. First term. (1)

340. Dynamo Testing. Lectures on the methods of testing electrical machinery and apparatus, including direct and alternating current generators, and motors, rotary converters, transformers, potential regulators, and motor-generator sets. Special methods of testing large machines. Commercial tests as carried out by the large manufacturing companies. Preparation required: 307, 309, 315, 333. First term. (1)

341. Dynamo Laboratory. Direct current. Experimental studies and tests of direct current motors, dynamos, and appliances, for characteristics, regulation, efficiency, insulation, etc. Applications of 316 and 331. Preparation required: 309, 315. First term. (3)

342. Shorter course for students in the course in Electrometallurgy. First term. (2)

317. Theory of Alternating Currents. Given in the department of Physics. Continuation of 316. Advanced theoretical studies of transformers, induction motors, and transmission lines. Preparation required: 316, 335, 336, 337, 340, 341. Second term. (3)

343. Electrical Design. Continuation of 337. Calculations of alternating current apparatus, including generators, motors, transformers, and rotary converters and leading up to original designing; drafting. Preparation required: 316, 335, 337. Second term. (2)

344. Electric Traction. The construction, equipment and operation of different types of electric railways. The application of electric traction under steam railroad conditions; the dynamics of electric train movement; predeterminations of speed-time curves and the power required for different types of runs. Choice of car equipment; cost of construction and of operation. Testing of railway systems. Visits of inspection to power plants are made and reports required. Preparation required: 316, 335, 337, 338, 339. Second term. (2)

345. Electric Power Transmission. The long distance transmission of power by electricity for use in lighting, traction, mining and manufacturing work. Comparison of electric transmission with other systems. The design, construction, maintenance and protection of lines; the effects of inductance and capacity on the operation of the power system; the generating plant and receiving systems. Preparation required: 316, 335, 337, 338, 339. Second term. (2)

346. Electrical Engineering Seminary. Continuation of 339. Reports on thesis work are presented and discussed. Preparation required: 316, 335, 337, 338, 339. Second term. (1)

347. Dynamo Laboratory. Alternating current. Experimental studies and tests of alternating current generators and motors, rotary converters, transformers and auxiliary apparatus. Meas-

urement of power in polyphase circuits. Preparation required: 316, 335, 340. Second term. (2)

348. Electrotechnology. This study includes a review of the principles of electricity and magnetism with special reference to their application to dynamo electric machinery, the elementary theory of dynamos and motors, and the study of the operation, regulation, management, and methods of testing dynamos and motors. Illustrative problems. Preparation required: 300 to 306 inclusive. First term. (2)

349. Electrotechnology, (Electric Railways). Continuation of 348. General survey of the more important industrial applications of electricity. This study is specially adapted to the needs of Civil and Mining engineers; particular attention is given to the generation, distribution, and utilization of electricity for lighting and power. Illustrative problems. Preparation required: 348. Second term. (2)

350. Inspection Report. During the vacation between the Junior and Senior years each student in electrical engineering is required to inspect some electric railway system, lighting or power plant, or other electrical installation, and prepare a written report thereon. A descriptive outline of the installation which the student proposes to inspect must be submitted to the Professor of Electrical Engineering before July 15th, and after approval the detailed report must be handed in before September 21st. These reports should contain such calculations, photographs, drawings and plots as each individual case may require, and their length will usually be from twenty to thirty pages of letter paper.

351. Thesis for the Degree of E.E. Each candidate for the degree of Electrical Engineer is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term, and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory, experimental research, or designing. Reports of progress on thesis work are required from time to time during the term. Much importance is attached to the thesis as evidence of the candidate's ability to carry out an independent investigation. Second term. (3)

Beginning with the second term, Freshman year, a deposit of $10 each term to cover breakage, wear and tear of apparatus,

appliances, etc., in the departments of Physics or Electrical Engineering, is required of each student. The unused balance of the deposit is returned to the student.

For Summer Schools see Courses 171, 330, 176, and 350, also statement on page 78.

CHEMISTRY.

PROFESSOR CHANDLER,

ASSISTANT PROFESSOR SCHOBER, ASSISTANT PROFESSOR ULLMANN, MR. DIEFENDERFER, MR. BUCH, MR. BECK, MR. GARRISON.

360. General Introduction to Theoretical Chemistry. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings, lantern pictures, and specimens from the museum. Note-books on the lectures required. Reference book: Remsen's Inorganic Chemistry, Advanced Course. First term. (2)

361. Chemical Laboratory. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. First term. (2)

362. Qualitative Analysis. Practical work in the qualitative laboratory, accompanied by lectures. Text-book: Prescott and Johnson's Qualitative Chemical Analysis. Second term. (6)

363. Qualitative Analysis. Shorter courses. Second term. (3), (2), or (1)

364. Stoichiometry. Chemical problems, and reactions. Text-book: Thorpe and Tait's Chemical Calculations. Second term. (2)

365. Chemical Philosophy. Theories of Chemistry; physical and chemical methods of determining atomic and molecular weights, solutions, electrolysis, thermo-chemistry, etc. Text-books: Tilden's Chemical Philosophy; Whitley's Chemical Calculations; Remsen's Inorganic Chemistry, Advanced Course. First term. (3)

366. Quantitative Analysis. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds. Text-book: Fresenius's Quantitative Analysis, edited by Allen and Johnson. First term. (6)

367. Quantitative Analysis. Shorter course. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores, and metallurgical products. First term. (3)

368. QUANTITATIVE ANALYSIS CONFERENCE. Discussions concerning the laboratory work of course 366. First term. (1)

369. QUANTITATIVE ANALYSIS. Continuation of course 367. Second term. (4)

370. QUANTITATIVE ANALYSIS. Continuation of course 366. Analysis of minerals, ores, slags, alloys, etc. Text-books: Fresenius's Quantitative Analysis, Blair's Chemical Analysis of Iron. Second term. (6)

371. QUANTITATIVE ANALYSIS. Shorter course. Second term. (3) or (2)

372. QUANTITATIVE ANALYSIS CONFERENCE. Discussions concerning laboratory work of course 370. Second term. (1)

373. THEORETICAL CHEMISTRY. The elements and their compounds. Text-book: Remsen's Chemistry, Advanced Course. Second term. (3)

374. TOXICOLOGY. Lectures illustrated by experiments and by a large collection of specimens of poisons from the museum of chemistry, and supplemented by a short course of laboratory work on some of the common poisons. First term. (2)

375. QUANTITATIVE ANALYSIS. Continuation of course 370. Ores and alloys; complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Text-books: Fresenius's Quantitative Analysis edited by Allen and Johnson, Hempel's Gas Analysis. First term. (6)

376. QUANTITATIVE ANALYSIS. Shorter course. Second term. (3) or (2)

377. QUANTITATIVE ANALYSIS CONFERENCE. Discussions concerning the laboratory work of course 375. First term. (1)

378. QUANTITATIVE ANALYSIS. Continuation of course 369. Analysis of ores and metallurgical products, and gas analysis. First term. (3) or (2)

379. ORGANIC CHEMISTRY. Illustrated lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of converting compounds of one class into those of another. Text-books: Remsen's Introduction to the Study of the Carbon Compounds; Richter's Organic Chemistry, translated by Smith. First term. (5)

380. ORGANIC CHEMISTRY. Practical laboratory work. Determination of specific gravities, melting points, boiling points, vapor densities; also of chlorine, bromine, iodine, and sulphur

of organic substances. Combustion analysis, nitrogen determination, fractional distillation, and the preparation of fifty pure organic compounds. Text-books: Gattermann's Practical Methods of Organic Chemistry, translated by Schober; Levy's Anleitung zur Darstellung Organischer Präparate. Second term. (6)

381. Organic Chemistry Conference. Discussions concerning the laboratory work of course 380. Second term. (1)

382. Industrial Chemistry. Preparation of a number of chemically pure inorganic salts from minerals, commercial products, etc.; of various dyes and dye mixtures, and the dyeing of cotton, silk, and woolen fabrics; calico printing; manufacture of coal gas; fermentation; bleaching. First term. (3)

383. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, antimony, gold, silver, and iron; also gold and silver bullion analysis by processes practiced in the United States Mint. Text-book: Rickett's and Miller's Notes on Assaying. First term. (3)

385. Industrial Chemistry. Lectures on the chemical industries, illustrated by experiments, diagrams, lantern pictures, and specimens from the museum of chemistry. Second term. (3)

386. Industrial Analysis. Analysis of commercial products. Laboratory work. Text-book: Allen's Commercial Organic Chemistry. Second term. (3)

387. Industrial Analysis Conference. Discussion concerning the laboratory work of course 386. Second term. (1)

388. Agricultural Chemistry. The application of chemistry to problems in agriculture. Laboratory work. Second term. (1)

389. Sanitary Chemistry. Qualitative and quantitative examination of air, water, food, disinfectants, baking-powders, flour, bread, tea, coffee, cocoa, spices, milk, butter, lard, beer, and other subjects connected with this branch of the science. Second term. (1)

390. Physical Chemistry. Lectures and recitations. Text-book: Jones's Physical Chemistry. First term. (1)

391. Physical Chemistry. Laboratory work. Determination of molecular weights and physico-chemical measurements. First term. (1)

392. Electrochemistry. Lectures. Second term. (1)

393. Electrochemistry. Laboratory work. Preparation of chemicals by electrolysis. Electrochemical measurements. Second term. (1)

394. Technical German. Recitations based on German texts dealing with chemical subjects. Text-book for 1905: Ostwald's Schule der Chemie, Part II. Second term. (1)

395. Medical Chemistry. Adapted to the needs of students anticipating the study of medicine. Second term. (3)

396. Theses for the Degrees of A.C. and Ch.E. Preparation of a thesis on some subject, approved by the Professor of Chemistry, involving practical work in the laboratory and use of the library, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

Deposits to cover breakage, chemicals, etc., are required in the above courses, as follows: Five dollars each in courses 391 and 393; ten dollars each in courses 361, 384, 386, and 388; fifteen dollars in course 389; twenty dollars each in courses 378 and 382; twenty-five dollars each in courses 363, 367, 371, and 376; thirty dollars each in courses 362, 366, 369, 370, 375, and 383; thirty-five dollars in course 380. The unused portion of the deposit is returned to the student.

Summer Schools. Courses in Qualitative and Quantitative Analysis, and Assaying, begin June 15, 1905, and continue five weeks. They are open to all persons prepared to take them.

PHYSICAL CULTURE.

DR. DAVIS.

410. Gymnasium. Graded calesthenic drills; heavy apparatus under group leaders. First term. (2)

411. Gymnasium. Calesthenics and heavy gymnastics in more advanced work. Class track practice. Preparation required: 410. Second term. (2)

All students of the University are admitted to these classes in Physical Culture.

SUMMER SCHOOLS.

The summer schools in shop inspection and sketching of machine parts, at the end of the Freshman year in the courses of Mechanical Engineering, Electrical Engineering, Metallurgical Engineering, Electrometallurgy, and Chemical Engineering, and

in Mechanical Technology at the end of the Sophomore year in these courses, the summer school in Topographic Surveying in the courses of Civil Engineering, Mining Engineering, and Geology at the end of the Sophomore year, the summer school in Mine and Railroad Surveying in the courses of Mining Engineering and Geology at the end of the Junior year, and also the summer school in Engineering Laboratory in the course of Chemical Engineering at the end of the Junior year are required studies and are therefore to be regarded as the summer terms of the courses. In the course of Mechanical Engineering the summer schools in Engineering Laboratory and in Marine Engineering, which are held at the end of the Junior year, are required courses in their respective courses. Likewise the instruction in Land Surveying at the end of the Freshman year is required of the students in the courses of Mining Engineering and Geology, but is extra for the students in the course in Civil Engineering. Students not connected with the University may be admitted to the courses in Surveying if properly qualified. For this purpose special arrangement must be made with the Professor of Civil Engineering for the courses in Land and Topographic Surveying, and with the Professor of Mining Engineering for the course in Mine and Railroad Surveying.

In addition to this required summer work, there are also summer schools in Mathematics, Strength of Materials, Hydraulics, Chemistry, Physics, German, and French designed primarily for students of the University who are deficient in these subjects. But others not connected with the University may be admitted if properly qualified. These last mentioned summer schools, with the exception of the summer schools in Chemistry, begin in August. A special circular giving details, fees required, etc., will be sent to those applying for it.

SCHOOL OF GENERAL LITERATURE.

PURPOSE AND METHOD.

The purpose of this department of the University is to provide systematic courses of study which shall meet the requirements of a liberal education, and lay the foundation for the study of the several professions and for the intelligent following of business and industrial pursuits. The University desires that these courses be not merely academic in character, but of practical worth, and sustain a direct relation to the sphere of life which each student has before him. That the culture-purpose which is the basis of them may not be ignored, a limited amount of work in subjects of a literary, philosophic, and scientific character, which are both accepted instruments of culture and necessary preliminaries of all higher study, is required of each student. The required work includes courses in the English, German, French, Latin, and Greek languages and literatures, in mathematics, physics, chemistry, economics, psychology, and philosophy. Beyond this the work is elective. Until the second term of the Sophomore year the studies are prescribed; from then on they become increasingly subject to the student's own choice.

In pursuance of the policy of making these courses practical and directly preparatory to each student's life-work, large freedom is allowed in the choice of electives. Any study which is taught in the University may be taken, subject to the qualification and purpose of the student. Students are counseled to select their work systematically with reference to some definite end. In this they receive the assistance and coöperation of the Faculty, under the oversight of one of whose members each student arranges his course. Endeavor is made to treat students individually rather than in groups, and to suit the work of each to his needs and qualifications. Instruction is given by lectures, by recitations, by the assignment of readings and of topics for special study and dissertations, and when the subject admits of it, by practical work in field or laboratory. Field-work or laboratory work accompanies courses in surveying, geology, physics, chemistry, astronomy, biology, psychology, and allied subjects.

ADMISSION, CLASSIFICATION, DEGREE.

The requirements for admission are stated in detail on pages 22 to 24. On the basis of these the studies of the School of General Literature are classified, for the sake of convenience, into the Classical and Latin-Scientific courses. Greek is required in the Classical course; its place is taken in the Latin-Scientific course by modern languages, mathematics, and science. Except for such separation as grows necessarily out of this difference in the qualifications for admission the two courses are parallel.

The course of study extends over four years. Students, however, who can do so, are permitted to pass off required work in advance and to fill up the time thus left free with other advanced studies, with a view to completing the requirements for graduation in a shorter time.

The degree of Bachelor of Arts is bestowed upon all graduates of the School of General Literature.

PREPARATION FOR LAW, MEDICINE, TEACHING, ETC.

Young men who have in view the profession of law, medicine, theology, teaching, or journalism, will find in the courses of study which this department of the University offers that general and special preliminary training which is more and more becoming essential. For the better preparation of such men for entrance upon their professional studies the University is constantly enlarging its curriculum as need determines. Laboratory work has been added to the courses in psychology, and the completion of Williams Hall has made possible better facilities for the teaching of biology and zoölogy, and the addition of courses in bacteriology. The opportunities for preliminary medical studies which the University thus affords are unsurpassed.

COMBINATION OF LITERARY AND TECHNICAL STUDIES.

The desirability of a liberal training for an engineer has led the University to offer courses in which, by combining the studies of the several technical departments with the work of the School of General Literature, a student may gain both a literary and a professional education, with the corresponding degrees, in six years. These courses possess decided advantages over the usual engineering curriculum of four years, the studies of which are necessarily almost wholly technical; and the value of the wider training for which they provide far outweighs the extra expendi-

ture of time. The outline in full of a combined course leading to the degrees of B.A. and C.E. is printed on pages 86 and 87.

TABULAR EXHIBITION OF STUDIES.

The following tables of studies exhibit the required and the ordinary elective studies of the School of General Literature. These peculiarly technical studies which enter into the combined courses are not here printed in the lists of electives. Further information regarding this department of the University, the systematic arrangement of work preparatory to professional study, to teaching, etc., can be found in the circular of the School of General Literature, copies of which may be had by addressing the Registrar of the University.

THE CLASSICAL COURSE.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Sol.Geom.and Trig.,(4)	110,111	Algebra and Trig.,(5)	113,114
Greek, (4)	40	Greek, (4)	41
Latin, (4)	30	Latin, (4)	31
German, (2)	74	German, (2)	75
English, (3)	90, 91, 95	English, (2)	92, 95
Hygiene, (2)	279	Public Speaking, (1)	108
Gymnasium, (2)	410	Gymnasium, (2)	411

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM (*Required*).	
Greek, (3)	42	Greek, (3)	43
Latin, (3)	32	Latin, (3)	33
German, (3)	78	German, (3)	79
French, (2)	60	French, (2)	61
English, (2)	93, 96	English, (2)	94, 96
Physics, (3)	303	(*Elective, four hours*)	
Physical Laboratory, (1)	304	Greek, (2)	44
Public Speaking, (1)	109	Latin, (2)	34
		History, (2)	23
		Descriptive Geometry,(3)	131
		*Land Surveying, (4)	133
		Physics, (3)	305
		Physical Laboratory, (1)	306
		Botany, (2)	270
		Forestry, (1)	271
		Physiography, (3)	257

*May be taken in the Summer Term after the Sophomore year.

JUNIOR YEAR.

FIRST TERM (*Required*).	
Psychology, (2)	3
Economics, (2)	10
English, (1)	97
European History, (1)	20
Chemistry, (2)	360
Chemical Laboratory, (2)	361
(*Elective, seven hours*)	
Greek, (3)	45
Latin, (3)	35
French, (3)	64
German, (2)	80
English, (3)	99
History, (2)	24
Mechanics, (4)	112
Analytic Geometry, (5)	115
Elec. and Magnetism, (2)	307
Electrical Laboratory, (1)	308
Crystallography, (2)	220
Geology, (2)	250
Biology, (3)	272
Pedagogy, (1)	7

SECOND TERM (*Required*).	
Psychology, (2)	4
Economics, (2)	11
European History, (1)	20
(*Elective, twelve hours*)	
Greek, (3)	46
Latin, (3)	36
French, (3)	65
German, (2)	81
English, (3)	100
Italian, (3)	89a
History, (2)	25
Calculus, (5)	116
Astronomy, (3)	118
Alternating Currents, (2)	315
Electrical Laboratory, (1)	309
Mineralogy, (3)	221
Blowpipe Analysis, (1)	223
Qualitative Analysis, (3)	363
Stoichiometry, (2)	364
Geology, (2)	251
Zoölogy, (3)	273
Pedagogy, (1)	7

SENIOR YEAR.

FIRST TERM (*Required*).	
History of Philosophy, (2)	1
(*Elective, fifteen hours*)	
Greek, (3)	47
Latin, (3)	37
German, (2)	82 *or* 84
French, (2)	68 *or* 70
Spanish, (2)	88a
Italian, (2)	89b, 89c
English, (3)	101
Economics, (2)	12
Public Law, (2)	14 *or* 16
Analytic Mechanics, (2)	117
Theory of Light, (5)	310
Alternating Currents, (2)	316
Chemical Philosophy, (3)	365
Quantitative Anal., (3)	367
Lithology, (2)	250
Geology, (3)	256
Bacteriology, (2)	276
Psychology, (2), (3), *or* (4)	5,6
History of Education, (1)	8

SECOND TERM (*Required*).	
History of Philosophy, (2)	2
Thesis, (3)	
(*Elective, twelve hours*)	
Greek, (3)	48 *or* 49
Latin, (3)	38
German, (2)	83 *or* 85
French, (2)	69 *or* 71
Spanish, (2)	88b
Italian, (2)	89d
English, (3)	102 *or* 103
Economics, (2)	13
Public Law, (2)	15 *or* 17
Astronomy, (3)	118
Theory of Heat, (4)	311
Alternating Currents, (2)	317
Theoretical Chem., (3)	373
Quantitative Anal., (4)	369
Medical Chemistry, (3)	395
Physiography, (3)	257
Histology, (2)	274
Psychology, (2), (3), *or* (4)	5,6
History of Education, (1)	8

The figures in parentheses indicate the number of exercises per week.

THE LATIN-SCIENTIFIC COURSE.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113, 114
Latin, (4)	30	Latin, (4)	31
German, (3)	78	German, (3)	79
or French, (3)	64	*or* French, (3)	65
Freehand Drawing, (2)	125	English, (2)	92, 95
English, (3)	90, 91, 95	Descriptive Geometry, (3)	131
Hygiene, (2)	279	Public Speaking, (1)	108
Gymnasium, (2)	410	Gymnasium, (2)	411

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM (*Required*).	
Latin, (3)	32	Latin, (3)	33
German, (2)	80	German, (2)	81
French, (2)	60 *or* 66	French, (2)	61 *or* 67
English, (2)	93, 96	English, (2)	94, 96
Physics, (3)	303	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Chemistry, (2)	360	(*Elective, four hours*)	
Chemical Laboratory, (2)	361	Latin, (2)	34
Public Speaking, (1)	109	History, (2)	23
		*Land Surveying, (4)	133
		Qualitative Anal., (3)	363
		Stoichiometry, (2)	364
		Botany, (2)	270
		Forestry, (1)	271
		Physiography, (3)	257

JUNIOR YEAR.

FIRST TERM (*Required*).		SECOND TERM (*Required*).	
Psychology, (2)	3	Psychology, (2)	4
Economics, (2)	10	Economics, (2)	11
French, (3)	64	French, (3)	65
or German, (3)	78	*or* German, (3)	79
English, (1)	97	European History, (1)	20
European History, (1)	20	(*Elective, nine hours*)	
(*Elective, eight hours*)		Latin, (3)	36
Latin, (3)	35	German, (2)	83
German, (2)	82	*or* French, (2)	69
or French, (2)	68	English, (3)	100
English, (3)	99	Italian, (3)	89a
History, (2)	24	History, (2)	25
Analytic Geometry, (5)	115	Calculus, (5)	116
Elec. and Magnetism, (2)	307	Mineralogy, (3)	221
Electrical Laboratory, (1)	308	Blowpipe Analysis, (1)	223
Crystallography, (2)	220	Theoretical Chem., (3)	373
Chemical Philosophy, (3)	365	Quantitative Anal., (4)	369
Quantitative Anal., (3)	367	Alternating Currents, (2)	315
Geology, (2)	250	Electrical Laboratory, (1)	309
Biology, (3)	272	Astronomy, (3)	118
Pedagogy, (1)	7	Geology, (2)	251
		Zoölogy, (3)	273
		Pedagogy, (1)	7

*May be taken in the Summer Term after the Sophomore year.

SENIOR YEAR.

FIRST TERM (*Required*).		SECOND TERM (*Required*).	
History of Philosophy, (2)	1	History of Philosophy, (2)	2
(*Elective, fifteen hours*)		Thesis, (3)	
Latin, (3)	37	(*Elective, twelve hours*)	
French, (2)	70	Latin, (3)	38
German, (2)	84	French, (2)	71
Spanish, (2)	88a	German, (2)	85
Italian, (3)	89b, 89c	Spanish, (2)	88b
English, (3)	101	Italian, (2)	89d
Economics, (2)	12	English, (3)	102 *or* 103
Public Law, (2)	14 *or* 16	Economics, (2)	13
Analytic Mechanics, (2)	117	Public Law, (2)	15 *or* 17
Alternating Currents, (2)	316	Astronomy, (3)	118
Theory of Light, (5)	310	Physiography, (3)	257
Organic Chemistry, (5)	379	Alternating Currents, (2)	317
Geology, (3)	256	Theory of Heat, (4)	311
Bacteriology, (2)	276	Histology, (2)	274
Psychology, (2), (3), *or* (4)	5,6	Medical Chemistry, (3)	395
History of Education, (1)	8	Psychology, (2), (3), *or* (4)	5,6
		History of Education, (1)	8

The figures in parentheses indicate the number of exercises per week.

COMBINED ACADEMIC AND ENGINEERING COURSES.

The University considers it desirable that young men who expect to follow an engineering profession receive a broader education than is possible in an engineering course of four years' duration which must of necessity be occupied almost exclusively by subjects of a technical and professional character. A good many subjects which are essential to an engineering curriculum are proper also to academic courses. But an academic student who subsequently proceeds to engineering study often finds that his training in these common branches has been inadequate to the successful application of them to engineering work. Time can be saved and more efficient preparation given when they are under one common guidance. The University is able, by systematically combining the studies of its several engineering schools with the studies peculiar to the School of General Literature, to offer courses of six years' duration which lead to the degree of Bachelor of Arts and an engineering degree, and in which neither the purpose nor the efficiency of either course is sacrificed. Students in these courses receive the Bachelor's degree at the end of four years, the engineering degree upon the completion of the engineering studies.

Following is an outline in full of such a course leading to the degrees of Bachelor of Arts and Civil Engineer. For the sake of brevity, the course is printed only for a Latin-Scientific student, who has presented German for admission. Classical students, or Latin-Scientific students presenting French for admission, may select a similar course. Combined courses leading to other engineering degrees are also provided.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113,114
Latin, (4)	30	Latin, (4)	31
German, (3)	78	German, (3)	79
Freehand Drawing, (2)	125	English, (2)	92, 95
English, (3)	90, 91, 95	Descriptive Geometry, (3)	131
Hygiene, (2)	279	Public Speaking, (1)	108
Gymnasium, (2)	410	Gymnasium, (2)	411

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Latin, (3)	32	Latin, (3)	33
German, (2)	80	German, (2)	81
French, (2)	60	French, (2)	61
English, (2)	93, 96	English, (2)	94, 96
Physics, (3)	303	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Chemistry, (2)	360	Land Surveying, (4)	133
Chem. Laboratory, (2)	361		
Public Speaking, (1)	109		

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Psychology, (2)	1	Psychology, (2)	2
Economics, (2)	10	Economics, (2)	11
English, (1)	97	European History, (1)	20
French, (3)	64	Qualitative Anal., (3)	363
European History, (1)	20	Calculus, (5)	116
Analytic Geometry, (5)	115	(*At least four hours from following.*)	
(*At least three hours from following.*)		Latin, (3)	36
Latin, (3)	35	English, (3)	100
English, (3)	99	German, (2)	83
German, (2)	82	French, (3)	65
Biology, (3)	272	Italian, (3)	89a
History, (2)	24	Zoölogy, (3)	273
Pedagogy, (1)	7	History, (2)	25
		Pedagogy, (1)	7

SENIOR YEAR.

FIRST TERM.

History of Philosophy, (2) 1
Construction, (2) 137
Stereotomy, (4) 132
(*At least nine hours from following.*)
Latin, (3) 37
German, (2) 84
French, (2) 70
Spanish, (2) 88a
Italian, (3) 89b, 89c
English, (3) 101
Economics, (2) 12
Public Law, (2) 14 *or* 16
History of Education, (1) 8
Quantitative Anal., (3) 367
Blowpipe Analysis, (1) 224
Geology, (3) 252

SECOND TERM.

History of Philosophy, (2) 2
Construction, (2) 138
Botany, (2) 270
Thesis, (3)
(*At least eight hours from following.*)
Latin, (3) 38
German, (2) 85
French, (2) 71
Spanish, (2) 88b
Italian, (3) 89d
English, (3) 102
Economics, (2) 13
Public Law, (2) 15 *or* 17
History of Education, (1) 8
Geology, (2) 253
Quantitative Anal., (4) 369
Sanitary Biology, (2) 275

SUMMER TERM.

Topographic Surveying, 134.

FIFTH YEAR.

FIRST TERM.

Analytic Mechanics, (2) 117
Strength of Materials, (4) 142
Railroads, (2) 139
Cement Testing, (1) 140
Graphic Statics, (5) 145
Crystallography, (2) 220

SECOND TERM.

Railroad Surveying, (5) 135
Hydraulics, (3) 149
Roofs and Bridges, (3) 146
Astronomy, (3) 118
Mineralogy, (2) 222

SUMMER TERM.

Engineering Inspection, 152.

SIXTH YEAR.

FIRST TERM.

Bridge Design, (5) 147
Sanitary Engineering, (2) 150
Mech. of Machinery, (2) 177
Electrotechnology, (2) 348
Dams and Arches, (2) 141
Geology, (2) 250
Geodetic Surveying, (3) 136
or Prac. Astronomy, (3) 119

SECOND TERM.

Bridges, (2) 148
Sanitary Engineering, (2) 151
Metallurgy, (3) 234
Geology, (2) 251
Steam Engine, (3) 174
Electric Railways, (2) 349
or Sanitary Biology, (2) 275
or Steel Buildings, (2) 143
Thesis, (3) 153

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN CIVIL ENGINEERING.

The requirements for admission to this course may be found on pages 24 and 25. While French will be accepted instead of German, it is recommended that the latter be offered, as its technical literature is of greater value to the civil engineer.

The program of studies of this course, given on page 91, shows the subjects required to be completed by candidates for the degree of Civil Engineer. The numbers following the subjects refer to the detailed descriptions on pages 38 to 78. The figures in parentheses indicate the number of exercises per week. Candidates for admission who are prepared to take an examination in the Chemistry of the Freshman year will be given an opportunity to do so, and those passing that examination will take Stoichiometry during the first term.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology and special training in those subjects comprised under the term civil engineering. The graduate is not only prepared to enter upon the location and construction work of railroads, bridges, water works, or sewerage plants, but can advantageously take up allied work in mining, mechanical, electrical, or architectural engineering.

During the Freshman year the time is mostly devoted to fundamental studies which give both general culture and preparation for the technical work of the following years. The study of Mathematics, Physics, English, and German is continued. Chemistry is taught partly by lectures and partly by practical manipulation in the laboratory. Drawing is done throughout the year, freehand sketching in the first term and instrumental work in the second. There are lectures in Physiology and Hygiene, and systematic exercise in the gymnasium is required.

In the Sophomore year the fundamental subjects of Mathematics, Physics, and English are completed, and the technical work of civil engineering is begun by practical problems in Drawing and by lectures on Construction. The theory of Land Surveying is begun and is accompanied by field work and map drawing. Those who desire to take this subject in the vacation at the end of the Freshman year will be allowed to do so under the regulations stated on page 53.

The work in Topographic Surveying is done in the four weeks following the end of the Sophomore year. By this arrangement the attention of the student is concentrated upon a single subject, thus enabling practical field operations to be exemplified in the best possible manner. In Railroad Surveying both preliminary and final locations of a line are made, and plans, profiles, and estimates of cost are prepared. In Geodetic Surveying triangulations of a high degree of precision are executed, as also determinations of azimuth, and adjustments of the results are made by the standard methods. A large collection of levels, transits, and other surveying tools enables the student to become familiar with the instruments of the best manufacturers.

Under the head of Construction are grouped the topics of masonry, foundations, roads and pavements, cements and mortars, walls, dams, arches, tunnels, and details of structures. The work covers three terms and is mainly by lectures, with references to standard books and engineering journals. Visits of inspection to structures in the Lehigh Valley and vicinity are made, and written reports upon them are required. All the standard tests of cements and mortars are made by each student. In connection with the subject of Strength of Materials there is also work in the testing laboratory on timber, brick, iron, and steel.

Roofs and Bridges receive attention throughout four terms. The analysis of trusses by graphic methods is begun in the first term of the Junior year and later the analytical methods of computing stresses are taken up. Visits are made to bridges and sketches taken of details which are afterwards drawn to scale. Later, designs and working drawings are prepared by each student for both highway and railroad bridges. These drawings are made, dimensioned, and checked in the same manner as in the drafting room of a bridge company, and estimates of the final weight of the structure are prepared. The theory of cantilever, draw, suspension, and arched structures also receives detailed attention. This extended training in bridge engineering furnishes a thorough foundation for successful work in practice.

Hydraulic and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes, and channels, together with the principles of hydraulic motors, is given in the Junior year, while in the Senior year the subjects of water supply and sewerage are discussed. The methods of

collecting, purifying, and distributing water are explained and compared; house drainage, the design of sewerage systems, and the disposal of sewage also receive attention. Computations for dams, standpipes, sewers and their appurtenances are made. Canal engineering, river and harbor work, and land drainage receive attention. Irrigation by both water and sewage is also discussed. This training in Hydraulic and Sanitary subjects, together with that in Construction, renders the graduate well qualified to enter upon the work of city engineering.

Among other required subjects may be noted that of Strength of Materials, which gives the theory of beams, columns, and shafts, and the methods of computing and designing them; as already noted, this subject is exemplified by practical work in the testing laboratory. The subject of Mechanics of Machinery treats of cranes, elevators and locomotives, and that of Electric Railroads of the equipment and operation of trolley roads. The subjects of Crystallography and Metallurgy give excellent training in the observation of natural phenomena, and prepare the student for work in geology and mining.

During the Senior year there are several elective subjects offered. In the first term the student may elect either Practical Astronomy or Geodetic Surveying; in the second term he may take Electric Railways, or Steel Buildings, or Sanitary Biology. Extra subjects may also be pursued, by permission of the Faculty, if the time of the student permits, and opportunity for the study of Spanish is afforded. In these subjects, as well as in all the work of this course, it is the aim to exemplify the theoretical principles by practical problems, inspections, designs or laboratory exercises. The testing laboratory of the University contains machines for making physical tests of tension, compression, flexure and torsion, and is of special value to students who prepare theses on investigations of the properties of materials.

The student who completes this course will receive the degree of Civil Engineer. Mature young men desiring to take special studies without being candidates for the degree will be afforded every facility in so doing. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated on page 29.

THE COURSE IN CIVIL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113,114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	Descriptive Geometry, (3)	131
or French, (3)	64	Forestry, (1)	271
Freehand Drawing, (2)	125	German *or* French, (3)	79 *or* 65
Hygiene, (2)	279	English, (2)	92, 95
English, (3)	90, 91, 95	Public Speaking, (1)	108
Gymnasium, (2)	410	Gymnasium, (2)	411

SUMMER TERM.

Land Surveying (optional), 133.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	115	Calculus, (5)	116
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Construction, (2)	137	Construction, (2)	138
Stereotomy, (4)	132	Land Surveying, (4)	133
English, (2)	93, 96	English, (2)	94, 96
Public Speaking, (1)	109		

SUMMER TERM.

Topographic Surveying, 134.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Mechanics, (2)	117	Railroad Surveying, (5)	135
Strength of Materials, (4)	142	Hydraulics, (3)	149
Railroads, (2)	139	Roofs and Bridges, (3)	146
Cement Testing, (1)	140	Astronomy, (3)	118
Graphic Statics, (5)	145	Economics, (1)	11
Economics, (1)	10	Mineralogy, (2)	222
Crystallography, (2)	220		

SUMMER TERM.

Engineering Inspection, 152.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Bridge Design, (5)	147	Bridges, (2)	148
Sanitary Engineering, (2)	150	Sanitary Engineering, (2)	151
Mech. of Machinery, (2)	177	Metallurgy, (3)	234
Electrotechnology, (2)	345	Geology, (2)	251
Dams and Arches, (2)	141	Steam Engine, (3)	175
Geology, (2)	250	Electric Railways, (2)	349
Geodetic Surveying, (3)	136	*or* Sanitary Biology, (2)	275
or Prac. Astronomy, (3)	119	*or* Steel Buildings, (2)	143
		Thesis, (3)	153

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines. The principal subjects taught are: the nature, equivalence, and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, mechanical technology, the principles and practice of machine design, and the measurement of power.

The earliest shop visits are for the purpose of acquainting beginners with machine parts and the usual tools of a shop. These visits are a part of the work of a summer term, lasting four weeks, which is held at the close of the second term of the Freshman year.

In this same summer term the students of Mechanical Engineering are also given a course in the examination of electrical instruments and machinery and in the inspection of their use and operation in electrical plants. This is regarded as a very desirable preliminary to the study of Physics and to the special course in Electrical Engineering which is pursued later on.

A second summer term at the end of the Sophomore year provides a course of shop instruction (Mechanical Technology) which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing the student with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery.

During the course there are frequent visits of inspection to the Bethlehem Steel Company, to the Lehigh Valley R. R. shops at Easton, and to other engineering works both in and out of town, with special reference to such subjects as prime movers, machinery for lifting, handling, and transporting, and machinery for changing the form and size of materials.

The instruction in Machine Design begins in the second term of the Freshman year and is continued throughout the course. At first, tracings and blue-prints of good examples of drawings of machinery are made. A thorough drill in projection drawing follows; in this work freehand sketches are first made, and measurements taken, of machine pieces; these sketches are then converted into full-sized drawings. Then there is considerable practice in the interpretation of such drawings, and general views of lathes, planers, drills, and shapers are made from the

drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the partial design of a high-speed steam engine, the leading dimensions being determined by the students. In the next year the Seniors undertake the calculations, estimates, and working drawings involved in the design of simple but complete machines, each student being engaged upon different machines. In the case of these machines and of the engine the general plan of arrangement will be given to the students in the form of rough sketches, photographs or woodcuts. In the last term the students are expected to make original designs for simple machinery, the object of which has been fully explained.

The students in Mechanical Engineering are given a special course in Electrical Engineering after they have finished the regular and general course in Physics. The object is to impart a clear conception of electrical units and a working knowledge of resistance, impedance, inductance, reactance, capacity, and the magnetism of iron, and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena, and to the theory of the alternating current transformer. Practical problems are given in these subjects to show their application. The laboratory work which accompanies this special course involves tests of resistance, insulation, consumption of energy, and efficiency. Instruction is also given in locating and remedying the common faults of dynamos and motors.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering; the simpler tests and experiments, along various lines, are taken up next; and there is a gradual progress toward complex operations as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing

of steam-traps and separators, and of injectors, small pumps, and the steam turbine; extensive practice with the indicator, engine tests of various sorts, and boiler testing.

Work with compressed air, tests of hot-air engines, of centrifugal pumps, and of various incidental appliances and apparatus, are to be given due place in the course. Gas engineering, in particular, will be well provided for when the new laboratory in Williams Hall is fully equipped. This laboratory will also be devoted to dynamometer work and power transmitting machinery, with experiments in friction and lubrication, and determination of the efficiency of machines.

The purpose of this course, kept in view in the equipment and arrangement of the laboratory, is to provide a system of well selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student, and give a broad training in the idea, method, and detail of this sort of work. For this course there is available the newly-constructed Steam Engineering Laboratory and the additional space reserved in Williams Hall for the experimental apparatus, machinery, and motors presented by Mr. Warren A. Wilbur to the department of Mechanical Engineering.

All the students in this course are required to study both German and French.

Graduates in this course receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MECHANICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113,114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	Draw'g and Mach.Des.,(3)	170
or French, (3)	64	German, (3)	79
Freehand Drawing, (2)	125	*or* French, (3)	65
Hygiene, (2)	279	English, (2)	92, 95
English, (3)	90, 91, 95	Public Speaking, (1)	108
Gymnasium, (2)	410	Gymnasium, (2)	411

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	115	Calculus, (5)	116
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Machine Design, (3)	172	Steam Engine, (4)	174
Boilers, (1)	173	French, (2)	61
French, (2)	60	*or* German, (2)	75
or German, (2)	74	English, (2)	94, 96
English, (2)	93, 96		
Public Speaking, (1)	109		

SUMMER TERM.

Mechanical Technology, 176.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Mechanics, (2)	117	Graphic Dynamics, (3)	180
Mech.of Machinery, (2)	177	Mech. of Machinery, (3)	181
Dynamos and Motors, (2)	332	Hydraulics, (3)	149
Elec. and Magnetism, (2)	307	Electrical Laboratory, (1)	309
Electrical Laboratory, (1)	308	Engineering Lab., (1)	179
Engineering Lab., (2)	178	Elec. Engineering, (2)	334
Strength of Materials, (4)	142	Alternating Currents, (2)	315
Economics, (1)	10	Economics, (1)	11
French, (2)	62	French, (2)	63
or German, (2)	76	*or* German, (2)	77

SUMMER TERM.

Engineering Laboratory, 182.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Thermodynamics, (3)	186	Machine Design, (6)	194
Kinematics of Mach., (4)	187	Engineering Lab., (1)	198
Machine Design, (5)	188	Metallurgy, (3)	234
Engineering Lab., (1)	190	Mech. of Machinery, (4)	197
Graphic Statics, (2)	144	*or* Steam Turbines, (4)	199
Mech. of Machinery, (2)	193	Thesis, (3)	210

A special option in Electrical Engineering may be arranged.

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN MARINE ENGINEERING.

The foundation for this course is that of Mechanical Engineering, which is closely followed by the Marine Engineering after the first two and a half years. During the second term of the Junior year and the whole of the Senior year the Marine and Naval Architecture subjects replace some of those given in Mechanical Engineering.

The course, though called Marine Engineering, includes much of Naval Architecture. In reality it embraces a large part of the theoretical and practical work of the design and construction of a modern steel ship, as well as the study and design of its machinery. The course throughout consists of class-room work carried on (as nearly as possible) parallel to, and simultaneously with, the drafting-room work.

At the end of the Junior year there is a summer term of four weeks devoted to acquiring the nomenclature of the constructive elements of a ship, to the study of practical ship-building in the shops and yards of ship-building establishments, and to observing arrangement of plants, sequence of work and the methods of laying out, handling, and erecting used with hulls in process of construction in the various yards. Attention is also paid to engine arrangement, construction and erection, and to the arrangement of auxiliary machinery, piping and boilers on board ship.

At the beginning of the Senior year the student selects a design and from then on all practice in arranging, calculating and designing is made on that particular design as far as possible. Further details of the course are given in the list of studies on pages 38 to 78.

Graduates in this course receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MARINE ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113,114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	Draw'g and Mach.Des., (3)	170
or French, (3)	64	German, (3)	79
Freehand Drawing, (2)	125	*or* French, (3)	65
Hygiene, (2)	279	English, (2)	92, 95
English, (3)	90, 91, 95	Public Speaking, (1)	108
Gymnasium, (2)	410	Gymnasium, (2)	411

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	115	Calculus, (5)	116
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Machine Design, (3)	172	Steam Engine, (4)	174
Boilers, (1)	173	French, (2)	61
French, (2)	60	*or* German, (2)	75
or German, (2)	74	English, (2)	94, 96
English, (2)	93, 96		
Public Speaking, (1)	109		

SUMMER TERM.

Mechanical Technology, 176.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Mechanics, (2)	117	Mech. of Machinery, (3)	183
Mech. of Machinery, (2)	177	Hydraulics, (3)	149
Dynamos and Motors, (2)	332	Elec. Engineering, (2)	334
Elec. and Magnetism, (2)	307	Elec. Laboratory, (1)	309
Electrical Laboratory, (1)	308	Engineering Lab., (1)	179
Engineering Lab., (2)	178	Engineering Lab., (1)	192
Engineering Lab., (1)	191	Ship Calculations, (5)	200
Strength of Materials, (4)	142	French, (2)	63
French, (2)	62	*or* German, (2)	77
or German, (2)	76		

SUMMER TERM.

Constructive Elements of Ships, 205.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Thermodynamics, (3)	186	Machine Design, (5)	192
Kinematics of Mach., (4)	187	Metallurgy, (3)	234
Machine Design, (5)	188	Marine Engines, (2)	204
Ship Draw. and Des., (5)	201	Ship Design, (5)	203
Marine Boilers, (1)	202	Thesis, (3)	210

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN METALLURGICAL ENGINEERING.

This course is designed to prepare the student for practice in the field of Metallurgy. In addition to the general studies underlying all technical education, instruction is given in Freehand and Projection Drawing, the Strength of Materials, including work in the testing laboratory applied to stresses in metallic structures, Mechanical Technology, Steam Boilers, the Steam Engine, the Mechanics of Machinery, involving the study of hoisting and pumping engines, air compressors, blowing engines, fans, etc., and the graphic statics of mechanisms, the Measurement of Power, Hydraulics, including hydraulic motors, and Electrotechnology, including the theory of electric motors and dynamos and laboratory work in electrical measurements. The student is thus made acquainted with the principles involved in the design and construction of the buildings and machinery constituting a metallurgical plant and in the operation of the machines.

A thorough course is given in Physics, including laboratory work in mechanics and calorimetry.

In Chemistry, in addition to the training in chemical theory involved in the courses of Stoichiometry and Chemical Philosophy, much time is devoted to work in the laboratory, involving the qualitative and quantitative analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including gas analysis and dry assaying. The student is thus made thoroughly familiar with the principles of the two chief sciences on which the operations of metallurgy are based and with the methods of analysis employed in the laboratories of smelting works.

Courses in Mineralogy and Blowpipe Analysis involve practice in the identification of crystals and of minerals by their physical properties and their behavior before the blowpipe. The mineralogical laboratory affords facilities for advanced courses in geometric and physical crystallography which are not included in the ordinary curriculum. An elective course in Quantitative Blowpipe Analysis is open to a limited number of students.

A course in Lithology gives practice in the macroscopic examination of rocks and is followed by courses in Historic, Dynamic and Economic Geology, and by two terms work in the microscopic examination of rocks and of metallurgical materials.

A course in Ore Dressing renders the student familiar with the principles and methods of the mechanical preparation of ores and fuels.

The special instruction in Metallurgy is begun by a course in Metallurgical Construction. The class is taken on visits of inspection to neighboring metallurgical works. Each student makes sketches and takes notes of an assigned portion of the plant. From these working drawings are made and memoirs written describing and discussing the plant inspected. The student is thus rendered familiar with the furnaces and apparatus employed in metallurgical establishments, and with the methods in use in their drafting rooms. Courses of lectures in Metallurgy extend throughout the year. In these the chief weight is laid upon the chemical and physical principles involved in the various metallurgical processes. In order to impress these principles upon the mind of the student and to render their application familiar he is required to solve a series of problems which embody them. The problems are chiefly such as confront the metallurgist in his practice. In the course of Metallurgical Design the class is required to design a metallurgical plant to be operated under given conditions, a certain portion being assigned to each student. This involves calculations of stresses, weights and costs, the execution of working drawings and the discussion of the methods and apparatus chosen.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with Metallurgy to such advanced students as are competent to conduct them, while laboratory work is regularly given which includes practice in the use of calorimeters and pyrometers, and exercises in the methods of investigation and measurement which a metallurgist should know how to conduct.

The proximity of the works of the Bethlehem Steel Company and of the New Jersey Zinc Company, and the kindness of their officers, give opportunities for frequent visits of inspection by the students in classes and individually, and thus afford unusual facilities for the practical study of the metallurgy of iron and of zinc. Occasional visits of inspection are made to more distant works.

Graduates in this course receive the degree of Metallurgical Engineer (Met.E.).

THE COURSE IN METALLURGICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113,114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	Qualitative Analysis, (3)	363
or French, (3)	64	Stoichiometry, (2)	364
Freehand Drawing, (2)	125	German, (3)	79
Hygiene, (2)	279	*or* French, (3)	65
English, (3)	90, 91, 95	English, (2)	92, 95
Gymnasium, (2)	410	Public Speaking, (1)	108
		Gymnasium, (2)	411

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	115	Calculus, (5)	116
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Draw. and Met. Con., (4)	230	Blowpipe Analysis, (1)	223
Crystallography, (2)	220	Mineralogy, (3)	221
English, (2)	93, 96	Met. Con. and Draw., (3)	231
Public Speaking, (1)	109	English, (2)	94, 96

SUMMER TERM.

Mechanical Technology, 176.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Strength of Materials, (4)	142	Metallurgy, (5)	233
Boilers, (1)	173	Hydraulics, (3)	149
Geology, (3)	252	Geology, (2)	253
Ore Dressing, (3)	289	Economic Geology, (3)	254
Blowpipe Analysis, (1)	224	Quantitative Analysis, (4)	369
Chemical Philosophy, (3)	365		
Quantitative Analysis, (3)	367		

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Metallurgy, (4)	235	Mech. of Machinery, (4)	195
Assaying, (3)	383	Metallurgical Design, (2)	232
Quantitative Analysis, (3)	378	Metallurgical Lab., (1)	236
Electrotechnology, (2)	348	Steam Engine, (3)	175
Mech. of Machinery, (2)	177	Engineering Lab., (1)	192
Microscopic Petrology, (2)	261	Economics, (1)	11
Engineering Lab., (1)	191	Microscopic Petrology, (1)	262
Economics, (1)	10	Electrometallurgy, (1)	238
		Thesis, (6)	240

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN ELECTROMETALLURGY.

This course is designed to prepare the student to enter the rapidly developing fields of electrometallurgy and electrochemistry.

For the first two years the course is identical with that in Metallurgical Engineering, embracing fundamental instruction in mathematics, physics, mineralogy, drawing, and modern languages. In the third and fourth years this course agrees with the Metallurgical Engineering course in the inclusion of chemical analysis, chemical philosophy, metallurgy, ore dressing, boilers, steam engine, measurement of power and the general culture studies; it differs from it by devoting less time to assaying, by omitting certain courses in Civil and Mechanical Engineering, and by devoting the time thus gained to electrical and electrochemical subjects. The subjects thus introduced are Advanced Theory of Electricity and Magnetism, with practical work in measurement of current resistance, electromotive force, inductive capacity, magnetic testing of iron, etc.; Theory of Direct and Alternating-Current Dynamos and Motors, with experimental studies and tests, Electrical Generating Stations, Transmission and Receiving Systems; Theory of Electrolysis and Principles of Electrometallurgical and Electrochemical Practice, with experimental studies and tests in the laboratory.

Graduates in this course receive the degree of Electrometallurgist (El.Met.).

THE COURSE IN ELECTROMETALLURGY.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113,114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	Qualitative Analysis, (3)	363
or French, (3)	64	Stoichiometry, (2)	364
Freehand Drawing, (2)	125	German, (3)	79
Hygiene, (2)	279	*or* French, (3)	65
English, (3)	90, 91, 95	English, (2)	92, 95
Gymnasium, (2)	410	Public Speaking, (1)	108
		Gymnasium, (2)	411

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	115	Calculus, (5)	116
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Draw. and Met. Con., (4)	230	Blowpipe Analysis, (1)	223
Crystallography, (2)	220	Mineralogy, (3)	221
English, (2)	93, 96	Met. Con. and Draw., (3)	231
Public Speaking, (1)	109	English, (2)	94, 96

SUMMER TERM.

Mechanical Technology, 176.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Strength of Materials, (4)	142	Metallurgy, (5)	233
Boilers, (1)	173	Hydraulics, (3)	149
Ore Dressing, (3)	289	Quantitative Analysis, (4)	369
Chemical Philosophy, (3)	365	Alternating Currents, (2)	315
Quantitative Analysis, (3)	367	Electrical Eng., (2)	334
Blowpipe Analysis, (1)	224	Electrical Laboratory, (1)	309
Elec. and Magnetism, (2)	307		
Electrical Laboratory, (1)	308		
Dynamos and Motors, (2)	332		

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Metallurgy, (4)	235	Metallurgical Design, (2)	232
Quantitative Analysis, (3)	378	Engineering Lab., (1)	192
Blowpipe Analysis, (1)	224	Electric Power, (2)	343
Engineering Lab., (1)	191	Steam Engine, (3)	175
Electric Lighting, (2)	337	Dynamo Laboratory, (2)	347
Dynamo Laboratory, (2)	342	Electrometallurgy, (1)	238
Theory of Electrolysis, (1)	237	Metallurgical Lab., (1)	236
Electrical Laboratory, (1)	314	Economics, (1)	11
Electromet. Lab., (1)	239	Thesis, (6)	241
Economics, (1)	10		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN MINING ENGINEERING.

The object of this course is to prepare the student for practice in the field of Mining Engineering. It is designed to give him not only the thorough training of the engineer, but also that broadness of education which enables him to readily undertake the great variety of propositions which naturally present themselves to one of his profession.

The course is therefore a very broad one, and when completed, it places him in the path of a great number of opportunities. Not only will he have had sufficient practice and training to enable him to enter upon the field of mining, but he can also readily take up work in chemistry, geology, metallurgy, electrometallurgy, and in chemical, civil, electrical and mechanical engineering.

The principal objects in view, however, are that he may be enabled:—

First. To make surface and underground surveys, and to map the same; also to map the topography and geology of a district.

Second. To analyze substances encountered on a mining property, to value and report upon the same; and to analyze metallurgical products.

Third. To make mining, metallurgical or other designs to meet the requirements of given cases, and to enter upon the construction and take charge of the same.

Fourth. To take upon graduation a subordinate position as an engineer in connection with any of the previously mentioned lines of work.

In the Freshman year the time is principally devoted to laying a thorough foundation in the fundamental subjects of English, Modern Languages, Mathematics and Physics,—thus preparing the way for the technical and scientific studies of the following years. Lectures are given in Hygiene, and Gymnasium exercise under a competent director is required.

The course in Drawing begins, as soon as the student enters college, with freehand sketching of such objects as bear upon future work. Parallel with the preceding is taught Mechanical Drawing, in which course he learns the use of drawing instruments, makes drawings of machine parts of simple construction, makes tracings and blue prints, and solves problems in Descriptive Geometry. In Metallurgical Construction in the Sophomore

year he becomes familiar with metallurgical plant by making sketches and drawings of the same.

The Summer Schools in Land, Topographic, Mine, and Railroad Surveying, of four weeks each,—given at the close of the Freshman, Sophomore and Junior years respectively,—enable the student to concentrate his energies upon each subject and the practical operations therein involved. The last of these three schools is conducted partly in the mining regions and not only gives him practice in mine and railroad surveying, but enables him to study mining operations and mining plant from which data is obtained that facilitates class room work as well as that in Mining Design.

The course in Chemistry extends from the first term of the Freshman year to the middle of the Junior year. It begins with an introduction to general chemical theory and the elements,—supplemented by laboratory work; the subject is continued by qualitative and quantitative analyses and assaying; chemical problems and reactions are taught under Stoichiometry. The instruction includes the analysis, by standard methods, of common ores, fuels, gases and metallurgical products.

In Crystallography the student handles accurately made models of crystals. He is thereby introduced to Mineralogy which follows; carefully selected mineral specimens are thoroughly studied and the various means of identification are applied to more difficult types, the determination of which may be assisted and effected by Blowpipe Analysis.

Biology, besides giving an excellent training in the study of animal life, assists greatly in the study of Historical Geology; the study of living organisms, their structure, development, origin and distribution, is taken up in this course.

In the courses in Geology he learns the forms and structures of the rock masses of the earth's crust, and the forces which operate upon them. A brief review of historical geology follows, dealing with the fossil life of the earth and its application to the determination of the age of strata. Practice in Field Geology teaches him the methods by which rock formations are accurately mapped. Economic Geology treats of the formation of cavities in rocks and their relation to ore deposits, together with the manner in which the ores have been deposited;—the structure, geological horizon and distribution of the principal metallic and non-metallic deposits are then taken up.

The course in Petrology in the Junior year enables the common rock forming minerals to be readily identified by means of the microscope, especially when the constituents are too fine grained to be determined by the eye alone. The grouping of these minerals into rock textures is then taken up and by laboratory and field practice the student learns to recognize the main types of rocks.

In Boilers and Steam Engine the common types and accessories are fully treated; work in the Engineering Laboratory enables complete tests to be made upon the same, and their efficiencies and powers under varying conditions are calculated.

A thorough course in Strength of Materials treats of the theory and practice which governs the elasticity and strength of all forms of common materials which are used in constructions. Methods of computing and designing beams, columns, shafts, etc., and practical work in the testing laboratory are prominent features of this course. Hydraulics treats of the flow of water through orifices, mains, pipes and channels, and also of the principles of hydraulic motors.

The course in Graphic Statics gives the student the ability to analyze the forces which exist in roof trusses, beams and girders by the graphical method, while that in Mechanics of Machinery enables him to apply the same method to the determination of the direction and magnitude of all the forces acting in a machine.

The instruction in Mining Engineering is given in a series of courses which extend over the entire Junior and Senior years, under the following subdivisions: The subject of Ore-Dressing treats of the processes by which ores or fuels, direct from the mine, are rendered marketable. Prospecting, boring, mining, haulage and hoisting, drainage, ventilation, lighting and accidents treat of the steps by which minerals are discovered and valued, the manner in which they are extracted from the earth and brought to the surface, the means by which mines are maintained in an economical condition both from the standpoint of the mine owner and that of the miner, and finally the manner in which accidents may occur and the means for guarding against the same.

Mine Construction and Mine Administration treat respectively of the materials used in structures in and around mines, and of the methods of employing labor, keeping accounts, and of management.

In Metallurgy, the general principles of the subject, embracing fuels, furnaces, and processes, are thoroughly presented, followed by the metallurgy of iron and steel, copper, lead, silver, gold, zinc, mercury, and aluminium. Electrometallurgy familiarizes the student with the practical applications of electricity to metallurgical processes.

Electrotechnology, extending over the entire Senior year, embraces the study of the industrial applications of electricity which are of particular value to the mining engineer.

In Mining and Metallurgical Design the student embodies the foregoing principles and makes designs and working drawings of plant to fulfill given conditions.

A course in Spanish for the benefit of those who purpose practicing their profession in Spanish-speaking countries, is offered as an extra study during the Senior year.

The facilities for exemplifying the work of the course are almost unequalled. Numerous cement, slate and other quarries, ore and coal mines, are within easy distance, while in the same town are the great works of the Bethlehem Steel Co. and the spelter and oxide works of the New Jersey Zinc Co.

Graduates in this course receive the degree of Engineer of Mines (E.M.).

THE COURSE IN MINING ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig.,(5)	113,114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	Qualitative Analysis, (3)	363
or French, (3)	64	Stoichiometry, (2)	364
Freehand Drawing, (2)	125	Mechanical Drawing, (1)	291
Mechanical Drawing, (3)	291	German *or* French,(3)	79 *or* 65
Hygiene, (2)	279	English, (2)	92, 95
English, (3)	90, 91, 95	Public Speaking, (1)	108
Gymnasium, (2)	410	Gymnasium, (2)	411

SUMMER TERM.

Land Surveying, 133.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	115	Calculus, (5)	116
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Crystallography, (2)	220	Mineralogy, (3)	221
Quantitative Analysis, (3)	367	Blowpipe Analysis, (1)	223
Metallurgical Constr., (3)	231	Quantitative Analysis, (3)	371
English, (2)	93, 96	English, (2)	94, 96
Public Speaking, (1)	109		

SUMMER TERM.

Topographic Surveying, 134.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Ore Dressing, (3)	289	Mining Engineer'g, (2)	280, 281
Geology, (3)	252	Mining, (3)	282
Assaying, (3)	383	Metallurgy, (5)	233
Boilers, (1)	173	Geology, (2)	253
Strength of Materials, (4)	142	Petrology, (1)	262
Petrology, (2)	261	Steam Engine, (3)	175
Blowpipe Analysis, (1)	224	Hydraulics, (3)	149
Biology, (3)	272	Economics, (1)	11
Economics, (1)	10		

SUMMER TERM.

Mine Surveying and Mine Railroads, 290.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Min. Eng., (4)	283, 284, 285, 286	Mining Design, (4)	292
Mine Construction, (1)	287	Mine Administration, (1)	288
Metallurgy, (4)	235	Metallurgical Design, (2)	232
Electrotechnology, (2)	348	Electrometallurgy, (1)	238
Mech. of Machinery, (2)	177	Electrotechnology, (2)	349
Graphic Statics, (2)	144	Electrical Laboratory, (1)	309
Engineering Lab., (1)	191	Economic Geology, (3)	254
Field Geology, (2)	260	Engineering Lab., (1)	192
		Thesis, (3)	293

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN ELECTRICAL ENGINEERING.

The object of this course is, first, to give a broad education in general and scientific subjects, and second, to give training in those special studies which are of most value in the equipment of the electrical engineer. The course includes a number of special studies in civil, mechanical and metallurgical engineering, and the graduate in Electrical Engineering is prepared, by the broad technical training which the course offers, not only to enter any of the branches of electrical engineering, but also to deal with the related problems in mechanical engineering, civil engineering, and metallurgical engineering.

The fundamental studies in mathematics, physics, chemistry, and language, including English, are given in the early part of the course. These subjects include the more essential features of a broad education, and they furnish a preparation for the more advanced scientific and technical training to follow.

Technical work is begun during the summer term at the end of the Freshman year, continuing through the Sophomore year in the study of Boilers, Steam Engines and Machine Design. The Junior and Senior years are devoted almost exclusively to advanced technical work. Two terms of Economics are required during the Junior year.

The study of Electricity and Magnetism during the first term of the Sophomore year constitutes an introduction to the industrial applications of electricity.

The special studies in Mechanical Engineering included in this course are: Machine Design, begun in the second half of the Freshman year, is continued for one year. Constructive Elements of Machinery is given in the summer term at the end of the Freshman year in conjunction with the work in Constructive Elements of Electrical Apparatus. Boilers is given during the first term of the Sophomore year. Steam engine, following the study of boilers, is given during the second term of the Sophomore year. Mechanical Technology is given in the summer term at the end of the Sophomore year. This is a course in shop instruction intended principally to familiarize the student with the processes involved in pattern-making, moulding, forging, fitting and finishing. Frequent visits of inspection are made to manufacturing establishments in the vicinity. Following the work in

Mechanical Technology, the study of Mechanics of Machinery, Machinery of Transmission,and Graphic Dynamics is pursued during the Junior year, Mechanics of Machinery and Graphic Dynamics being elective during the second term. Engineering Laboratory is given throughout the Senior year. It includes the calibration of engineering measuring instruments and the performance of practical tests on boilers, engines, and pumps.

The following special studies in Civil Engineering are included in this course: Construction is given throughout the Junior year, consisting of lectures on masonry, foundations, cements and mortars, walls, dams, arches, tunnels, and details of structures; Strength of Materials, given in the first term of the Junior year, is concerned with the theory of beams, columns and shafts, and the methods of computing and designing them; the subject includes practical work in the testing laboratory; Hydraulics, given in the second term of the Junior year, treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes, and channels, naval hydromechanics, and hydraulic motors.

The special studies in Chemistry and Metallurgy are elective beginning with the second term of the Junior year. These studies include Stoichiometry and Qualitative Analysis, general Metallurgy, and Metallurgy of Iron and Steel. Lectures one hour per week on Theory of Electrolysis and Electrometallurgy may be taken as extras by students who have elected Chemistry in the second term of the Junior year.

The special studies in Electrical Engineering following Constructive Elements of Electrical Apparatus, and Electricity and Magnetism of the Sophomore year, are as follows: Advanced Theory of Electricity and Magnetism, begun in the first term of the Junior year, is devoted to the theory of electrical units and measurements, and to the advanced theory of electrostatics and the magnetism of iron. The accompanying laboratory work is devoted to precise electrical measurements, and the standardization and calibration of electrical measuring instruments. This theoretical work is followed by the study of the Theory of Alternating Currents during the second term of the Junior year and throughout the Senior year; this subject deals with the problems and methods of measurement which are peculiar to the modern practical applications of alternating currents, and with the theory underlying the action of the important types of alternating current machinery and transmission lines.

The study of Dynamo Electric Machinery is begun the first term of the Junior year, and includes electrodynamics, the construction, operation, and testing of direct current dynamos and motors, with numerous problems to illustrate the application of principles to concrete cases. The subject of Electrical Engineering, beginning in the second term of the Junior year, deals with the more important industrial applications of electricity to lighting and power distribution.

Dynamo laboratory work, beginning in the second term of the Junior year, is continued for three terms. The instruction given by printed notes is supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make a large number of actual tests on direct and alternating current generators and motors, rotary converters, transformers, and other electrical apparatus. Carefully written reports of all tests made, with curves plotted from the observations, and discussion of results, are required.

Dynamo Electric Machinery, both direct and alternating current, is again taken up at the beginning of the Senior year, and is continued through both terms. Special attention is paid to the application of electric and magnetic theory to the construction and operation of different types of electrical machinery.

The Electrical Engineering Seminary continues throughout the Senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class-room, and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign, and one of the principal objects of the Seminary work is to encourage the systematic reading of the current engineering journals. Reports on articles in the technical French and German periodicals are included as part of the work of the Seminary.

Dynamo Testing is given by lectures and problems during the first term of the Senior year, and treats of standard and special methods of making commercial tests on dynamo machines, transformers, and other electrical apparatus. Most of the methods discussed in the lectures are exemplified by the practical testing done in the dynamo laboratory.

Electric Lighting and Power Stations, given in the first term of the Senior year, constitutes an extension of the preliminary work given as Electrical Engineering during the second half of the Junior year. Under this subject are discussed the location,

design, and equipment of stations; the selection of suitable prime movers, generators, switchboards, and other apparatus. The use and operation of storage batteries and auxiliaries, the testing of arc and incandescent lamps, also receive consideration.

Electric Traction and Power Transmission are both given during the second term of the Senior year. Under Electric Traction are studied the construction, equipment and operation of different types of electric railways. The recent developments in the application of electric motive power to steam railroad conditions are discussed, and the results of tests analyzed. Practice is given in the estimating of the probable cost of building and operating an electric railway to fulfill certain specified conditions.

The subject of Electric Power Transmission deals with the various elements constituting a transmission system. It includes a study of the generating plant, the transmission line, and the receiving systems. Special attention is given to the design, construction, and protection of the line. Under the last three subjects are included visits of inspection to electric light and power stations, and to manufacturing establishments in the Bethlehems and out of town. Central station tests are made and reports required.

Electrical Design is begun in the first term of the Senior year and is pursued throughout the year. The work consists of a series of problems illustrating the application of electromagnetic laws to the calculation and proportioning of electrical machinery for a specified duty. Each student makes complete calculations and drawings for several types of apparatus, including electromagnets, direct and alternating current generators and motors, and transformers. The study of electrical design is intended to reënforce by concrete application the principles underlying the study of dynamo electric machinery.

Graduates in this course receive the degree of Electrical Engineer (E.E.).

A student in another college desiring to take the degree of Electrical Engineer at Lehigh University after graduation from college is strongly recommended in choosing his electives to anticipate as far as possible the studies of the Freshman and Sophomore years, as given in the following schedule, as well as those studies of the Junior and Senior years which are offered at his college. Specific regulations concerning admission to such advanced standing are given on page 26.

THE COURSE IN ELECTRICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113, 114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	Draw. and Mach. Des., (3)	170
or French, (3)	64	German, (3)	79
Freehand Drawing, (2)	125	*or* French, (3)	65
Hygiene, (2)	279	English, (2)	92, 95
English, (3)	90, 91, 95	Public Speaking, (1)	108
Gymnasium, (2)	410	Gymnasium, (2)	411

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 330.

SOPHOMORE YEAR.

Analytic Geometry, (5)	115	Calculus, (5)	116
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Machine Design, (3)	172	Steam Engine, (4)	174
Boilers, (1)	173	French, (2)	61
French, (2)	60	*or* German, (2)	75
or German, (2)	74	English, (2)	94, 96
English, (2)	93, 96		
Public Speaking, (1)	109		

SUMMER TERM. Mechanical Technology, 176.

JUNIOR YEAR.

Analytic Mechanics, (2)	117	Electrical Engineer'g, (2)	333
Elec. and Magnetism, (2)	307	Alternating Currents, (2)	315
Dynamos and Motors, (3)	331	Electrical Laboratory, (1)	309
Electrical Laboratory, (1)	308	Hydraulics, (3)	149
Strength of Materials, (4)	142	Construction, (2)	138
Mech. of Machinery, (2)	177	Economics, (1)	11
Construction, (2)	137	Mech. of Mach., (3,)	180
Economics, (1)	10	Graphic Dynamics, (3))	183
		or	
		Metallurgy, (3))	234
		Stoichiometry, (2))	364
		Qualitative Anal., (1))	363

SUMMER TERM.

Report on Inspection of Electrical Installation, 350.

SENIOR YEAR.

Theory of Alt. Cur., (3)	316	Theory of Alt. Cur., (3)	317
Dynamo Elec. Mach'y, (3)	335	Alt. Current Mach., (1)	336
Electrical Design, (2)	337	Electrical Design, (2)	343
Electric Lighting, (2)	338	Power Transmission, (2)	345
Dynamo Laboratory, (3)	341	Electric Traction, (2)	344
Dynamo Testing, (1)	340	Dynamo Laboratory, (2)	347
Electrical Seminary, (1)	339	Engineering Lab., (1)	192
Engineering Lab., (1)	191	Electrical Seminary, (1)	346
Advanced Elec. Lab., (1)	318	Thesis, (3)	351

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the professional chemist. It is also well adapted to the preparation of teachers of chemistry and as a course preliminary to the study of medicine.

Instruction in Theoretical Chemistry is begun in the first term of the Freshman year, with laboratory work in general inorganic chemistry. Stoichiometry, with practice in chemical problems, is taught in the second term of the Freshman year and is followed in the Sophomore year by Chemical Philosophy and Theoretical Chemistry. In the first term of the Junior year there is a course of lectures and recitations on Theoretical Organic Chemistry.

Qualitative Analysis is taught by lectures and laboratory work in the second term of the Freshman year. This is followed by courses in Quantitative Analysis throughout the Sophomore and first term of the Junior year. This course includes Gas Analysis. Furnace Assaying and the assay of gold and silver bullion are taught in the first term of the Senior year by lectures and laboratory work. The analysis of various commercial products is taken up in the second term of the Senior year, also the subjects of Sanitary and Agricultural Chemistry and Toxicology. Instruction is also given in Manufacturing Chemistry, Dyeing, Calico Printing, and Bleaching. Blowpipe analysis also is included in the course.

The practical work in Organic Chemistry is performed in the second term of the Junior year, with laboratory work and conference. There are courses of practical Microscopy and Electrochemistry, and Toxicology. Physical Chemistry is taught by text-book and laboratory work. In the Senior year the student prepares a thesis on some chemical subject, involving laboratory work.

The laboratory for qualitative analysis is a large, well-ventilated, and well-lighted room, supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances, and a commodious room for hydro-

sulphuric acid. Distilled water is delivered by faucet in this room and other large laboratories.

The quantitative laboratory is equipped like the qualitative laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

The gas laboratory is supplied with full and complete apparatus for gas analysis, according to Orsat's, Hempel's, and Bunsen's processes.

The assaying laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

The laboratory for organic chemistry is equipped similarly to the quantitative laboratory, in addition being supplied with steam, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas's, and Meyer's apparatus for vapor densities, nitrometers, chemical balances, etc.

The working laboratories for industrial chemistry contain an apparatus for making illuminating gas, an alcohol still, worm and doubler, and a complete working model of a sugar refinery, including filters, vacuum pan, and centrifugal. There is also apparatus for use in the manufacture of chemicals, for dyeing, calico printing, and bleaching. In connection with these laboratories is a room containing a photometer and apparatus for determining the sulphur, ammonia, and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates, tallow, illuminating and lubricating oils, rubber, explosives, asphalts, and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City. A well-equipped photographic laboratory and dark rooms are provided, in which the students of the Chemical course receive practical instruction. Bacteriology includes a course of lectures and laboratory work with the microscope.

Graduates in this course receive the degree of Analytical Chemist (A.C.).

THE COURSE IN CHEMISTRY.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Qualitative Analysis, (6)	362
Chemistry, (2)	360	Stoichiometry, (2)	364
Chemical Laboratory, (2)	361	Physics, (2)	300
German, (3)	78	Physical Laboratory, (1)	301
or French (3)	64	German, (3)	79
Freehand Drawing, (2)	125	*or* French (3)	65
Hygiene, (2)	279	English, (2)	92, 95
English, (3)	90, 91, 95	Public Speaking, (1)	108
Gymnasium, (2)	410	Gymnasium, (2)	411

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Chemical Philosophy, (3)	365	Physics, (3)	305
Quantitative Analysis, (6)	366	Physical Laboratory, (1)	306
Quant. Anal. Conf., (1)	368	Quantitative Analysis, (6)	370
Physics, (3)	302	Quant. Anal. Conf., (1)	372
Physical Laboratory, (1)	304	Theoretical Chemistry, (3)	373
English, (2)	93, 96	English, (2)	94, 96
Public Speaking, (1)	109		

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Toxicology, (2)	374	Organic Chem. Lab., (6)	380
Quantitative Analysis, (6)	375	Organic Chem. Conf., (1)	381
Quant. Anal. Conf., (1)	377	Metallurgy, (5)	233
Organic Chemistry, (5)	379	Mineralogy, (3)	221
Crystallography, (2)	220	Blowpipe Analysis, (1)	223
Economics, (1)	10	Economics, (1)	11
English, (1)	98	Technical German, (1)	394

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Metallurgy, (4)	235	Industrial Chemistry, (3)	385
Assaying, (3)	383	Industrial Analysis, (3)	386
Industrial Chem. Lab., (3)	382	Indus. Anal. Conf., (1)	387
Bacteriology, (2)	276	Agricult'l Chem. Lab., (1)	388
Blowpipe Analysis, (1)	224	Sanitary Chem. Lab., (1)	389
Physical Chemistry, (1)	390	Geology, (2)	253
Physical Chem. Lab., (1)	391	Electrochemistry, (1)	392
Geology, (3)	252	Electrochem. Lab., (1)	393
		Electrometallurgy, (1)	238
		Electromet. Lab., (1)	239
		Thesis, (3)	396

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN CHEMICAL ENGINEERING.

This course of study is designed to prepare students for the profession of the chemical engineer, engaged in the construction and management of manufacturing establishments involving chemical principles, such as sugar refineries, gas works, superphosphate works, bleacheries, dye works, oil refineries, fertilizer works, soap works, sulphuric acid plants, soda works, etc.

In addition to many of the subjects in the Course in Chemistry, it includes the subjects of elementary mechanics, boilers, steam engine, drawing and machine design, constructive elements of machinery, measurement of power, mechanics of machinery, mechanical technology, and work in the engineering laboratory. It also includes electricity and magnetism, dynamos and motors, and work in the electrical and dynamo laboratories.

In this course the training is essentially chemical and the graduates are primarily chemists with a good knowledge of mechanical engineering.

This equipment is considered more valuable for the chemical engineer than a fundamental training in engineering and a somewhat limited knowledge of chemistry, since the problems of the manufacturing chemist are not essentially mechanical ones. Although six years' work covering most of the studies of both the chemical and mechanical courses would be found advantageous for the chemical engineer, this shorter course, of four years, will be found to meet most of his requirements.

Graduates of this course receive the degree of Chemical Engineer (Ch.E.).

THE COURSE IN CHEMICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113,114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	Qualitative Analysis, (3)	363
or French (3)	64	Stoichiometry, (2)	364
Freehand Drawing, (2)	125	German, (3)	79
Hygiene, (2)	279	*or* French, (3)	65
English, (2)	90, 91, 95	English, (2)	92, 95
Gymnasium, (2)	410	Public Speaking, (1)	108
		Gymnasium, (2)	411

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 171, 336.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Chemical Philosophy, (3)	365	Theoretical Chemistry, (3)	373
Quantitative Analysis, (6)	366	Quantitative Analysis, (2)	371
Quant. Anal. Conf., (1)	368	Steam Engine, (4)	174
Boilers, (1)	173	Draw. and Mach. Des., (3)	170
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
English, (2)	93, 96	English, (2)	94, 96
Public Speaking, (1)	109		

SUMMER TERM.

Mechanical Technology, 176.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Quantitative Analysis, (2)	378	Organic Chem. Lab., (6)	380
Organic Chemistry, (5)	379	Organic Chem. Conf., (1)	381
Engineering Lab., (2)	178	Metallurgy, (5)	233
Elec. and Magnetism, (2)	307	Engineering Lab., (1)	179
Electrical Laboratory, (1)	308	Electrical Eng., (2)	334
Dynamos and Motors, (2)	332	Electrical Laboratory, (1)	309
Machine Design, (3)	172	Technical German, (1)	394
English, (1)	98		

SUMMER TERM.

Engineering Laboratory, 182.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Industrial Chem. Lab., (3)	382	Industrial Chemistry, (3)	385
Assaying, (3)	383	Industrial Analysis, (3)	386
Metallurgy, (4)	235	Industrial Anal. Conf., (1)	387
Bacteriology, (2)	276	Agricult'l Chem. Lab., (1)	388
Engineering Lab., (1)	190	Sanitary Chem. Lab., (1)	389
Mech. of Machinery, (2)	177	Electrochemistry, (1)	392
Physical Chemistry, (1)	390	Electrochem. Lab., (1)	393
Physical Chem. Lab., (1)	391	Electrometallurgy, (1)	238
Economics, (1)	10	Electromet. Lab., (1)	239
		Economics, (1)	11
		Thesis, (3)	396

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN GEOLOGY.

The course in Geology is almost the same as that in Mining Engineering up to the end of the Sophomore year and differs in only a few respects from it up to the end of the first term Junior year. It is designed for those who wish the thorough grounding of the engineering course, but whose tastes lead them into the natural sciences rather than into technical lines. The studies for the first two years are equally necessary for the thoroughly educated man in either, and by this arrangement the student is not required to decide which course he will follow until he has had an opportunity to test his own tastes and abilities.

After completing the course in Geology one year of graduate work will enable the student to secure the degree of Engineer of Mines and the graduate from the Mining Engineering course in the same way, by taking a year's work in the geological specialties as a major subject with the addition of a minor subject from another department, can complete the course in Geology and receive the degree of Master of Science.

The course meets the requirements of the teacher of the natural sciences, the field geologist, or the prospecting and exploring engineer, and furnishes especially a broad, thorough basis for the subsequent prosecution of original research. Throughout the entire four years the work gives a first-hand knowledge of the subjects taught and cultivates self-reliance and the powers of perception and exact reasoning. For those who may wish ultimately to become specialists in some one of the different branches of Geology this course is recommended with a year of graduate work at one of the larger Universities.

It includes the Mathematics and Physics taught in the technical courses, thus ensuring an ability to grasp and solve the problem of geological dynamics. A year's knowledge of French or German is necessary for entrance and this is continued by a year and a half of work in the same language. Two years' work in the other language is required during the Junior and Senior years, so that by the end of the course the student feels at home with foreign periodical literature in both French and German. Spanish also is taught during the Senior year.

A thorough knowledge of Surveying is considered at the present time indispensable to the field geologist, and the courses,

being the same as those for the mining engineer, not only offer a ready means of livelihood for young men just graduated, but afford practice in accurate mapping and give the proper basis for the interpretation of topography. The course in geodesy gives the methods of triangulation and the adjustment by least squares.

The preliminary courses in Crystallography, Mineralogy, Petrology, and Geology are the same as those given to the mining engineers and will permit the student with slight effort not only to recognize any of the constituents of the earth's crust, but to value the portion surveyed from an economic standpoint as it is adapted or not for mining operations. In addition to these are the more purely scientific courses. Throughout the Junior year three periods a week are set aside for field Geology to accompany the first year's work. The Petrology is continued through the second term Junior year; the student, having passed briefly over the general subject of Petrology, spends this time in studying some particular phases and becoming familiar with detailed methods which cannot be given in the briefer course. A course in advanced Geology devoted chiefly to Paleontology runs through the Senior year, a text-book being used and the student handling and identifying numerous invertebrate fossils. It is not designed to make a paleontologist, but to give that amount of systematic knowledge and ability to identify fossils which should be possessed by the stratigraphical geologist or to give a basis for one who wishes to pursue the subject further.

The several branches of Geology are so widely separated and require such different kinds of ability that in the second term Senior year an opportunity is given for the student to specialize. In the studies in Pennsylvania Geology he takes up some branch of the subject, reads the literature that bears upon it, and makes field studies over regions within reasonable distances. Original research is more properly left for graduate work, but this course is preparatory to it by showing the student the extent to which he must go before hoping to turn out new material. Some phases of the subject, however, embracing his own observations and deductions may properly be handed in for a thesis.

The ordinary courses in Geology are extended by excursions into the foundations of Botany, Zoölogy, and Biology, and supplemented by work in the field in the courses of Surveying and Physiography. The ability readily to determine the character

and value of the ores and minerals met with is guaranteed by extended courses in Crystallography, Mineralogy, Megascopic and Microscopic Rock Analysis, Economic Geology, and both Chemical and Blowpipe Analysis. The course in Chemistry includes assaying, quantitative wet analysis and the discussion of chemical problems, so that mineralogical formulae can be calculated from the results of analyses. The blowpipe courses cover qualitative and quantitative work. Economic Geology is taught in a thorough manner and applied by courses in refractory materials and general metallurgy which contain problems depending upon the composition and impurities of ores and gangues; and by a course in prospecting which treats of the presentation of ores and gangues at the surface and the rules for their discovery.

The courses in general Metallurgy and Hydraulics are of indirect scientific value to the geologist, since the first renders him familiar with the composition, behavior, and fluidity of slags, as well as with blast furnace reactions, and the course in hydraulics develops the principles of moving fluids with their practical applications and serves as an introduction to the subject of geologic dynamics.

Beginning in the first term Junior year the student is given the choice of making the course a purely scientific one, or one embracing a little more technical work, assaying and mining engineering being made an alternative option with field work in geology.

Graduates in this course receive the degree of Bachelor of Science (in Geology).

THE COURSE IN GEOLOGY.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113,114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	German, (3)	79
or French, (3)	64	*or* French, (3)	65
Freehand Drawing, (2)	125	Qualitative Analysis, (3)	363
Mechanical Drawing, (3)	291	Stoichiometry, (2)	364
Hygiene, (2)	279	Mechanical Drawing, (1)	291
English, (3)	90, 91, 95	English, (2)	92, 95
Gymnasium, (2)	410	Public Speaking, (1)	108
		Gymnasium, (2)	411

SUMMER TERM.

Land Surveying, 133.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	115	Calculus, (5)	116
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Crystallography, (2)	220	Mineralogy, (3)	221
Chemical Philosophy, (3)	365	Blowpipe Analysis, (1)	223
German, (2)	76	English, (2)	94, 96
or French, (2)	62		
English, (2)	93, 96		
Public Speaking, (1)	109		

SUMMER TERM.

Topographic Surveying, 134.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Geology, (3)	252	Geology, (2)	253
Biology, (3)	272	Petrology, (1)	262
Petrology, (2)	261	Quantitative Analysis, (3)	371
Blowpipe Analysis, (1)	224	Metallurgy, (3)	234
Quantitative Analysis, (3)	367	Economics, (1)	11
Economics, (1)	10	French, (2)	61
French, (2)	60	*or* German, (2)	75
or German, (2)	74	Botany, (2)	270
English, (1)	98	Field Geology, (3)	259
Field Geology, (3)	258	*or* Mining Eng., (2)	280, 281
or Assaying, (3)	383		

SUMMER TERM.

Mine Surveying, 290.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Geology, (4)	255	Physiography, (3)	257
Field Geology, (2)	260	Hydraulics, (3)	149
Geodetic Surveying, (3)	136	French, (3)	63
Graphic Statics, (2)	144	*or* German, (3)	77
French, (3)	62	Spanish, (2)	88b
or German, (3)	76	Economic Geology, (3)	254
Spanish, (2)	88a	Geology of the U. S., (3)	256
		Thesis, (3)	264

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN PHYSICS.

The requirements for admission to this course are the same as the requirements for entrance to the School of Technology as explained on pages 24 and 26.

The object of the course is to give a broad education, together with sufficient training in mathematics, physics, and chemistry to enable the graduate to enter upon the career of teaching, or to undertake a post-graduate course in the physical sciences or in mathematics.

The required studies in the course include fundamental branches which are essential in every college course, advanced studies in mathematics and physics, and the introductory courses to electrotechnology: namely, the Theory of Dynamos and Motors and the Theory of Alternating Currents. Every teacher of physics and every advanced student of physics should be familiar with the peculiarly instructive exemplifications of physical principles which are to be found in the practical application of electricity and magnetism.

As far as possible the same electives are offered during the Junior and Senior years. The available electives of the second term depend, however, upon the work which has been done during the first term; for example, Mineralogy is open only to those who have taken Crystallography. The character and scope of these elective studies and of the various required studies in the course, are described in the List of Studies on pages 38 to 78.

Graduates in this course receive the degree of Bachelor of Science (in Physics).

THE COURSE IN PHYSICS.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Mechanics, (4)	112	Algebra and Trig., (5)	113,114
Chemistry, (2)	360	Physics, (2)	300
Chemical Laboratory, (2)	361	Physical Laboratory, (1)	301
German, (3)	78	Qualitative Analysis, (2)	363
or French, (3)	64	Stoichiometry, (2)	364
Freehand Drawing, (2)	125	German, (3)	79
Hygiene, (2)	279	*or* French, (3)	65
English, (3)	90, 91, 95	English, (2)	92, 95
Gymnasium, (2)	410	Public Speaking, (1)	108
		Gymnasium, (2)	411

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	117	Calculus, (5)	116
Physics, (3)	302	Physics, (3)	305
Physical Laboratory, (1)	304	Physical Laboratory, (1)	306
Chemical Philosophy, (3)	365	Descriptive Geometry, (3)	131
French, (2)	60	French, (2)	61
or German, (2)	74	*or* German, (2)	75
English, (2)	93, 96	English, (2)	94, 96
Public Speaking, (1)	109		

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Mechanics, (2)	117	Alternating Currents, (2)	315
Elec. and Magnetism, (2)	307	Electrical Laboratory, (1)	309
Dynamos and Motors, (2)	332	French, (3)	63
Electrical Lab., (2)	308, 309	*or* German, (3)	77
French, (3)	62	Economics, (1)	11
or German, (3)	76	(*Elective, ten hours*)	
Economics, (1)	10	History, (2)	23
English, (1)	98	European History, (1)	20
(*Elective, four to six hours*)		Economics, (2)	13
European History, (1)	20	Public Law, (2)	15
Economics, (2)	12	Psychology, (2)	4
Psychology, (2)	3	Hydraulics, (3)	149
Public Law, (2)	14	Mineralogy, (3)	221
Crystallography, (2)	220	Metallurgy, (3)	234
Organic Chemistry, (5)	379	Astronomy, (3)	118
Strength of Materials, (4)	142		
Drawing, (4)	132		

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Theory of Light, (5)	310	Theory of Heat, (4)	311
Physical Laboratory, (2)	312	Physical Seminary, (2)	313
Physical Seminary, (2)	313	Thesis, (3)	319
(*Elective, eight hours*)		(*Elective, eight hours*)	
European History, (1)	20	European History, (1)	20
History, (2)	24	History, (2)	23 *or* 25
Economics, (2)	12	Economics, (2)	13
Psychology, ( )	3	Public Law, (2)	15 *or* 17
Public Law, (2)	14 *or* 16	Psychology, (2)	4
Crystallography, (2)	220	Hydraulics, (3)	149
Organic Chemistry, (5)	379	Mineralogy, (3)	221
Strength of Materials, (4)	142	Geology, (2)	251
Practical Astronomy, (3)	119	Metallurgy, (3)	234
Geology, (2)	250	Astronomy, (3)	118
Drawing, (4)	132		

The figures in parentheses indicate the number of exercises per week.

GRADUATING THESES.

Every student is required to present a thesis upon some topic connected with the course from which he is to graduate, as a necessary portion of the exercises for his final examination for a degree. These theses are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the Faculty.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.

THE UNIVERSITY MUSEUMS.

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Zoölogy and Archaeology.

The Metallurgical Cabinet includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Museum is located in the west end of Williams Hall, and contains collections of fossils, specimens of ore from mining districts, and extensive series of rocks which illustrate the type occurrences in different parts of the world. There is also a duplicate set of the rocks collected by the Second Geological Survey of Pennsylvania.

The Cummings Archaeological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons, and utensils.

UNIVERSITY LECTURES.

From time to time during the University year, distinguished members of the various professions are invited to lecture before the students upon those special subjects to which they have given particular attention and upon which they are authorities.

The following lectures were given in this course during the years 1902-1903 and 1903-1904.

Mr. Theodore Marburg, "Shorter Hours for Labor."

Mr. Charles J. Bonaparte, "Civil Service Reform."

Mr. C. O. Mailloux, "Some Factors Bearing on the Career and Success of an Engineer."

Dr. T. M. Drown, "Some Facts and Fallacies About Drinking Water."

Prof. William T. Sedgwick, "The Sanitation of Cities."

Mr. Horace E. Deming, "Education and Democracy."

Mr. Howard W. Du Bois, "Camping Expeditions in the Rockies of British Columbia."

Prof. Angelo Heilprin, "Mt. Peleé and the Tragedy of Martinique."

Mr. Stewart Culin, "Games of the Indians."

Dr. W. H. Tolman, "Social Studies in Great Britain, France, and Italy."

Prof. E. L. Stevenson, "Early Cartography of the New World."

Dr. Henry S. Pritchett, "Comparison of Technical Schools in Great Britain and the United States."

Prof. Thomas A. Jaggar, "Volcanoes and Geysers."

Dr. H. W. Wiley, "The Work of the Bureau of Chemistry in the U. S. Department of Agriculture."

Mr. Joseph L. Ferrell, "Protection of Wood Against Fire and Decay."

THE CHEMICAL AND NATURAL HISTORY SOCIETY OF LEHIGH UNIVERSITY.

This Society was organized in the fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of botanical and zoölogical specimens belonging to the Society are important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

THE ENGINEERING SOCIETIES.

The original Engineering Society was organized in 1873 and was open to all technical students of the University. From 1885 to 1890 it issued quarterly five volumes of "The Journal of the Engineering Society," containing contributions by the members, alumni, and others. Many of the papers read before this Society from 1890 to 1893 were published in "The Lehigh Quarterly."

Recently the Civil Engineering and Mechanical Engineering sections have formed independent societies, with monthly meetings for the reading and discussion of papers relating to engineering subjects of their particular departments.

THE ELECTRICAL ENGINEERING SOCIETY.

This Society was organized in 1887. Its object is to supplement the regular work in Electrical Engineering by the discussion of current topics in electricity and by lectures given under the auspices of the Society by engineers and by members of the corps of instructors in the department of Electrical Engineering.

THE FORUM.

The Forum, a literary and debating society which meets semi-monthly, was organized in 1897. This Society has proved of great advantage to its members in the development of concise and logical thinking, in the promotion of ease before an audience, and in the acquirement of experience in parliamentary methods. Through this Society the University is represented in the Pennsylvania Intercollegiate Oratorical Union. An annual contest in debate is held with representatives of the literary societies of several other colleges. The Forum has justified its existence by the great increase in the amount of attention given, not only to training in oratory and debate, but also to those subjects of the day which are constantly discussed at its meetings.

THE MATHEMATICAL CLUB.

This Club was organized in February, 1895. Its members are students in the Junior and Senior classes. Its object is to continue the study of higher mathematics after having completed the mathematical course of the University. It holds frequent meetings, at which papers are read and discussed by its members.

THE Y. M. C. A. OF THE UNIVERSITY.

This is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, a college graduate, being chosen from the student-body.

FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University. On Thursday, October 13, 1904, the twenty-fifth Founder's Day was celebrated. An address was delivered by Prof. Joseph French Johnson, Dean of the School of Commerce, of New York University. His subject was "Civic and Economic Responsibilities of the American University."

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day. The Rt. Rev. Frederick Burgess, D.D., Bishop of Long Island, was the preacher on Sunday, June 12, 1904, in the Packer Memorial Church.

THESES.

Theses on the following subjects were prepared by candidates for degrees in 1904.

FOR THE DEGREE OF MASTER OF ARTS.

HARVEY ERNEST JORDAN, B.A. (LEHIGH UNIV., 1903), Bethlehem.
The Development of Amia Calva.

FOR THE DEGREE OF BACHELOR OF ARTS.

HERBERT JOSEPH HARTZOG, South Bethlehem.
Economic Functions of the State.

CHARLES WILLIAM LÜDERS, Philadelphia.
A Brief History of Medical Science.

THOMAS ARCHER MORGAN (with C. R. Morss), Scranton.
The Structure and Development of the Amphibian Heart.

CLARENCE RUPERT MORSS (with T. A. Morgan), Scranton.
The Structure and Development of the Amphibian Heart.

LEIGH MERLE MORSS, Scranton.
The Problem of Colonial Government.

RALPH LUCAS TALLEY, Williamsport.
The Relations of Religion and Mythology.

ARTHUR JAMES WESTON, Scranton.
The Development of the Arthurian Legends.

FOR THE DEGREE OF CIVIL ENGINEER.

GEORGE BAILY, Baltimore, Md.
Location of an Electric Railway from South Bethlehem to Prospect Point, with Estimate of Cost.

LESTER BERNSTEIN, Philadelphia.
Comparison of Formulas for the Flood Flow of Streams and Determination of their Constants from Observations.

JACOB HERBST BRILLHART, York.
Plans for a Sewerage System and a Sewage Disposal Bed at York, Pa.

CARLETON WARD BUELL, Plymouth, Conn.
Comparison of Plate-girder Bridges with Pratt-truss Bridges for Short Spans.

HENRY FREAS CAMPBELL, Williamsport.
Economy in the Exchange of Low-district Sewerage at East and West Orange, N. J., with an Investigation of the Outlet Trunk Line.

AMOS HENRY CLAUDER, Bethlehem.
Comparison of Standpipes and Elevated Tanks with Respect to Economy of Cost.

LUIS CUESTA, Guadalajara, Mexico.
Dredging and Excavating Machinery for Canal and Railroad Construction.

WILLIAM E. DUNBAR, Harrisburg.
Plans for a Mechanical Filtration Plant for the Water Supply of Allentown, Pa.

HARRY ELIAS EDMONDS, Elmira, N. Y.
Plans for a Slow-sand Filtration Plant for the Water Supply of South Bethlehem, Pa.

JOHN WARREN FISHER, Williamsport.
Comparison of Different Types of Frogs and Switches from the point of view of the Maintenance of Way Department.

CLARENCE JONAS FREDERICI, Auburn, Pa.
Plan for Developing the Water Power of Bear Creek, Schuylkill Co., Pa.

NICHOLAS HUNTER HECK, B.A. (LEHIGH UNIV., 1903), South Bethlehem.
Long-time Tests of Hydraulic Cements and Mortars in Tension, Compression, and Flexure.

CARL SWING HERITAGE, Bridgeton, N. J.
Investigation of Two Spans of the New Street Bridge, built in 1875 and 1903.

HENRY LANDON JACKSON, Scranton.
Comparison of Pile-driving Formulas and Theories, with a Discussion of Experiments.

RALPH GRANT JOHNSON, Washington, D. C.
Plans for Sewers and for a Sewage Disposal System at Larchmont Park, N. Y.

MARCUS AUGUSTUS KECK, Bethlehem.
Plan for a Mechanical Filtration Plant for the Water Supply of South Bethlehem.

WILLIAM THURSTON MACCART, Williamsport.
Railroad Gravity Yards: their Advantages and the Conditions under which they may be Economically Used.

JOHN MCCLEARY, JR., Germantown.
Discussion of the Strength and Economy of Steel Freight Cars.

EDGAR MCCREREY MACK, Indiana.
Plan and Estimate for a new Water Supply of Lehigh University.

JOHN MEREDITH MILLER, Sewickley.
Locomotive Turntables in the Bethlehems, with a Design for a new one.

DONALD JULIAN PACKER, Trenton, N. J.
Graphical Methods for Investigating and Designing Masonry Dams and Arches.

WILLIAM CALLAND POLLITT, Philadelphia.
Location of an Electric Railway from Lehigh University to Prospect Point, with Estimate of Cost.

WALTER SOUDER SLIFER, Lansdale.
Location of an Electric Railway from South Bethlehem to Prospect Point, with Estimate of Cost of Construction.

JOHN CLAYTON SNYDER, Harrisburg.
Determination of Azimuth with the Engineer's Transit and with the Solar Attachment.

SWINTON BALL WARING, Charleston, S. C.
Theories of Concrete-Steel Floors, with the Discussion of Experiments.

EMERY STONE WHITNEY, JR., Bethlehem.
Comparative Estimate of Crib and Masonry Dams for Enlarged Impounding Reservoir at Mt. Holly Springs, Pa.

RAY FRANKLIN WUNDERLY, Nazareth.
Comparison of Several Cement Plants, with respect to Economy of Construction and Operation.

CHARLES ERNEST YOST, Middletown.
Plan and Estimate for a Disposal Plant for the Sewage of South Bethlehem, Pa.

FOR THE DEGREE OF MECHANICAL ENGINEER.

CHARLES GREEN BAUMGARTNER, Asbury Park, N. J.
Design of an Electric Light Plant for Beach and Pavilions at Asbury Park, N. J.

LUTHER BECKER, Schuylkill Haven.
A Discussion of Mechanical Draft.

CLINTON JOEL BLOSS, Slatedale.
Report of Changes in Machine Tools due to Use of High Cutting Speeds.

HAROLD GRANT BONNER, Florida, N. Y.
Test of an Otto Gas Engine.

SAMUEL LEROY CAUM, Altoona.
Plans and Estimates for Ozonizing Plant for the Sterilization of the Water Supply of Bethlehem, Pa.

ALEXANDER LARDNER DORNIN, Norfolk, Va.
Test of a Steam Plant in Norfolk, Va.

LOUIS EDWARD FARABAUGH, Altoona.
Discussion of Existing American Stokers.

RANDOLPH EDWARD SPENCER GEARE, Washington, D. C.
Dynamometers and Measurement of Power in Shops.

GEORGE KENDRICK GOODWIN, Philadelphia.
The Tempering of Tool Steel.

JOHN JACOB GRABBE, Mitan, Russia.
Causes of Boiler Explosions and how to Avoid Them.

OLIVER JACOB HALLER, Pittsburg.
The General Problem of Speed Control and the Evolution of the Mechanical Variable Speed Drive.

SAMUEL HENRY HODGES, Norfolk, Va.
Test of a Steamship Under Voyage Conditions.

RAMSEY DANIEL KAVANAUGH, Williamsport.
Efficiency Test of Boiler and Engine at Holmes' Silk Mill, Williamsport, Pa.

BERT MOSS KENT, Rome, N. Y.
Plans and Estimates for a 5000 K. W. Power Station using Steam Turbines.

LOUIS GHEEN MCCAULEY, Susquehanna.
Design of a High-Pressure Pump for Hydraulic Forging.

FRANK JAMES MCDEVITT, Lancaster.
Experimental Study of Valve Gear Action in Automobiles.

WARREN COURTLAND MACFARLANE, Louisville, Ky.
Relative Merits of Belt Drive and Electric Drive for Machine Shops.

CHARLES LAW MOFFATT, Pittston.
Test of the Triple-Expansion Engine in the Lehigh University Steam Engineering Laboratory.

HOWARD MALLET PREVOST MURPHY, Philadelphia.
Design, Construction, and Test of a Constant Speed Roller, also Comparison Test of Governor Action.

WILLIAM UPDEGRAFF MUSSINA, Williamsport.
Plans and Estimates for a Steel Foundry.

JOHN FRANKLIN PELLY, Philadelphia.
Critical Examination of Various Types of Steam Turbine Units.

HAROLD SHIPPEN PIERCE, Philadelphia.
Investigation of the Development of Automobile Motors.

JOHN HOWELL POWELL, Freeland.
Efficiency Test of the Whole Steam Plant in the Silk Mill at Freeland, Pa.

HAROLD PATTERSON RENO, Pittsburg.
The Losses of Energy Involved in the Production and Transmission of Compressed Air.

WILLIAM ROY SHIVELY, Philadelphia.
Design of a Trestle for the Latrobe Steel and Coupler Co.

JESSE WAGGENER UNDERWOOD, Washington, D. C.
The Design of a Pumping Station for Mt. Pleasant District, Washington, D. C.

FOR THE DEGREE OF METALLURGICAL ENGINEER.

HOWARD GREEN BAYLES, East Orange, N. J.
The Corrosion of Underground Water and Gas Mains.

CHARLES ROLAND PEEBLES, Ashland, Ky.
The Manufacture of Steel in the Electric Furnace.

FOR THE DEGREE OF MINING ENGINEER.

MILTON BURNETT COBY, Minneapolis, Minn.
A Review of the Uses of Cement and Concrete in Mining Operations.

ANDREW JOSEPH FARABAUGH, Altoona.
The Raw Materials Used by the Bethlehem Steel Co.

RAY LIVINGSTON HERRICK Westfield, Mass.
Tests on the Applicability of the Electro-Cyanide Process to a Brazilian Gold Ore.

ROBERT PARKE HUTCHINSON (with F. P. Sinn), Washington, D. C.
A Study of Heats of Formation of Gold and Silver Amalgams.

FRANCIS PIERCE SINN (with R. P. Hutchinson), Germantown.
A Study of Heats of Formation of Gold and Silver Amalgams.

FOR THE DEGREE OF ELECTRICAL ENGINEER.

JACOB LYNFORD BEAVER (with S. S. Seyfert), Phoenixville.
An Investigation of Single-Phase Alternating Current Commutator Motors.

ROBERT CONNER BIRD (with B. A. Cornwell), Weatherly.
Tests of Alternating Current Transformers.

ABRAHAM GEORGE BOROWSKY (with G. H. Brandes), Philadelphia.
An Investigation of the Effects of Armature Reactions on the Regulation of Alternators.

GORDON HIRSH BRANDES (with A. G. Borowsky), Philadelphia.
An Investigation of the Effects of Armature Reactions on the Regulation of Alternators.

EDWARD CLAUDE BROWN (with C. L. Orth and S. S. Shive), Lock Haven.
An Investigation under Running Conditions of the Philadelphia Division of the Lehigh Valley Traction Co.'s Electric Railway System.

HORACE BROOKES CLEAVELAND (with W. A. Linn), Washington, D.C.
An Experimental Study of a Two-Phase Alternating Current Induction Motor.

BAXTER AUGUSTUS CORNWELL (with R. C. Bird), Washington, D.C.
Tests of Alternating Current Transformers.

JESSE BOWMAN HIRST, Roslyn, Va.
An Investigation of a Double Current Generator with Balancing Coils for Three-Wire Distribution.

WILLIAM ALEXANDER LINN (with H.B.Cleaveland), Hamburg, N.J.
An Experimental Study of a Two-Phase Alternating Current Induction Motor.

CHARLES LEONARD ORTH (with E. C. Brown and S. S. Shive), Washington, D. C.
An Investigation under Running Conditions of the Philadelphia Division of the Lehigh Valley Traction Co.'s Electric Railway System.

STANLEY SYLVESTER SEYFERT (with J. L. Beaver), Strausstown.
An Investigation of Single-Phase Alternating Current Commutator Motors.

STEWART SUMNER SHIVE (with E. C. Brown and C. L. Orth), York.
An Investigation under Running Conditions of the Philadelphia Division of the Lehigh Valley Traction Co.'s Electric Railway System.

RICHARD WAHLE, Buffalo, N. Y.
A Study of Apparatus for Measuring the Frequency of Alternating Currents.

FOR THE DEGREE OF ANALYTICAL CHEMIST.

HARVEY PETTIBONE BARNARD, Washington, D. C.
The Manufacture of Potassium Chlorate by the Electrical Process.

WILLARD LYNN BRUNER, Philadelphia.
The Weighting of Silks.

WILLIAM WARNER FITCH, Rome, N. Y.
The Quantitative Determination of Zinc.

LYLE RAY GARRISON, Yellow Springs, O.
The Separation and Properties of Radium from Pitchblende.

PAUL THEODORE KRAUSE, Bethlehem.
The Action of Nitric Acid on Ferrous Sulphate.

HORACE WEISER PFAHLER, Holyoke, Mass.
The Manufacture of Paper from Wood.

WILLIAM HENRY WELKER, Red Hill.
The Preparation and Properties of Silver Carbides.

UNIVERSITY DAY.

This day is the last of the academic year, and falls in 1905 on the second Wednesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

EXERCISES ON JUNE 15, 1904.

MUSIC.

PRAYER.

MUSIC.

Salutatory Oration.—"Mines and Economic Supremacy."
OLIVER JACOB HALLER.

MUSIC.

Oration.—"The Economic Aspect of Irrigation in the United States."
JACOB HERBST BRILLHART.

Oration.—"The Courts and Recent Uses of the Writ of Injunction."
RALPH LUCAS TALLEY.

MUSIC.

Alumni Address.—"Publicity."
ROBERT GRIER COOKE, B.A.,
Class of 1884.

Valedictory Oration.—"The Engineer in Modern Warfare."
HOWARD MALLET PREVOST MURPHY.

Address to the Graduating Class,
JOSEPH WHARTON, Sc.D., LL.D.

Award of the Wilbur Scholarship of $200 to
STEWART JOSEPH CORT, of Allegheny.
First in rank in the Sophomore Class.

The Williams Graduate Prize of $125, open to members of the classes of 1902, 1903, and 1904, was awarded to
ARTHUR JAMES WESTON, of Scranton.

The Williams Gold Medal of $100 value, open to members of the Senior Class, was awarded to
RALPH LUCAS TALLEY, of Williamsport.

The Alumni Prizes of $25 each, for first honor men in the Junior Class in various departments, were awarded to

SAMUEL HENRY FLEMING, of Philadelphia, in the Electrical Engineering Department, and

EARLEY MCILHENNY JOHNSON, of Steelton, in the departments of Mining Engineering, Metallurgical Engineering, and Electrometallurgy.

The Price Prize of $25 for English Composition, open to members of the Freshman Class, was awarded to

RALPH WILHELM KINSEY, of Reading.

The Williams Prizes of $10 and $5 for Excellence in English Composition, open to members of the Sophomore Class, were awarded to

DION KANOUSE DEAN, of Rahway, N. J.
JOHN HUSTON CLARK GREGG, of Catasauqua.
KENNETH MILLS, of Washington, D. C.
AUSTIN WILFORD MOORE, of Scranton.
STEWART JOSEPH CORT, of Allegheny.
JOHN HERBERT FARRELL, of Marquette, Mich.
HOWARD RAYMOND STOCKER, of Reading.
FRANK ALBERT VOCKRODT, of Pittsburg.

The Wilbur Prizes of $10 for excellence in the studies of the Sophomore year were awarded as follows:

In Mathematics, to

KENNETH MILLS, of Washington, D. C.

In English, to

JOHN HUSTON CLARK GREGG, of Catasauqua.

In Physics, to

WILLIAM WALTON CRAWFORD, of Richmond, Va.

Prizes of $5, to second honor men in the Sophomore year, were awarded as follows:

In Mathematics, to

MORRIS DE BERTHOLETTE EVANS, of Reisterstown, Md.

In English, to

NEWTON GUY SMITH, of Pottstown.

In Physics, to

AUBREY LEVIS BROOMALL, of Cheyney.

The Wilbur Prizes of $15 and $10, for excellence in the studies of the Freshman year, were awarded as follows:

In Mathematics, to

ROLLIN LANDIS CHARLES, of Allentown, and
MONTGOMERY JAMES GREENOUGH, of Four Paths, Jamaica.

In German, to

GEORGE KURT HERZOG, of Mickleton, N. J.

In French, to

MANUEL TEOFILO SALDAÑA, of San Juan, Porto Rico.

In English, to

HARRY FRAZIER ANDERS, of Frederick, Md.

Prizes of $15, $10, and $5, for Excellence in Declamation, open to members of the Freshman Class, were awarded to

ROY BECK WOODRING, of Allentown.
CLAUDE MAHLON DANIELS, of Pottstown.
EDWIN CALVIN PARKHURST, of York.

HONOR LIST, 1904.

SENIOR HONORS.

Classical Course.

First: ARTHUR JAMES WESTON, of Scranton.
Second: THOMAS ARCHER MORGAN, of Scranton.

Latin-Scientific Course.

HERBERT JOSEPH HARTZOG, of South Bethlehem.

Civil Engineering Course.

First: LESTER BERNSTEIN, of Philadelphia.
Second: CHARLES ERNEST YOST, of Middletown.

Mechanical Engineering Course.

First: HOWARD MALLET PREVOST MURPHY, of Philadelphia.
Second: OLIVER JACOB HALLER of Pittsburg.

Electrical Engineering Course.

First: STANLEY SYLVESTER SEYFERT, of Strausstown.
Second: RICHARD WAHLE, of Buffalo, N. Y.

JUNIOR HONORS.

Latin-Scientific Course.

First: NORMAN NATHANIEL MERRIMAN, of South Bethlehem.
Second: WILLIAM LAWRENCE ESTES, JR., of South Bethlehem.

Civil Engineering Course.

First: Horace Schultz Seipt, of Worcester.

Second: Wilson S. Barley, of Steelton.

Mechanical Engineering Course.

First: Charles Augustus Shaffer, of Harrisburg.

Second: Arthur Frederic Murray, of Bethlehem.

Electrical Engineering Course.

First: Samuel Henry Fleming, of Philadelphia.

Second: Edwin Louis Rich, of Washington, D. C.

Courses in Mining Engineering, Metallurgical Engineering, and Electrometallurgy.

First: Earley McIlhenny Johnson, of Steelton.

Second: Ralph G. Kirk, of Harrisburg.

SOPHOMORE HONORS.

In Mathematics.

First: Kenneth Mills, of Washington, D. C.

Second: Morris de Bertholette Evans, of Reisterstown, Md.

In English.

First: Stewart Joseph Cort, of Allegheny.

Second: John Huston Clark Gregg, of Catasauqua.

Third: Newton Guy Smith, of Pottstown.

In Physics.

First: William Walton Crawford, of Richmond, Va.

Second: Aubrey Levis Broomall, of Cheyney.

FRESHMAN HONORS.

In Mathematics.

First: Rollin Landis Charles, of Allentown.

Second: Montgomery James Greenough, of Four Paths, Jamaica.

In German.

George Kurt Herzog, of Mickleton, N. J.

In French.

Manuel Teofilo Saldaña, of San Juan, Porto Rico.

In English.

Harry Frazier Anders, of Frederick, Md.

Degrees were then conferred by the President of the University upon the candidates whose names appear in the Thesis List, as given above.

THE WILBUR SCHOLARSHIP.

This scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE HARRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship of the annual value of $200, which is to be devoted to the support at Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering.

THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS.

Friends of the late Frederick Mercur, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, have contributed and placed in the hands of the Trustees a fund, called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of four scholarships for free tuition in the University.

THE ECKLEY B. COXE MEMORIAL FUND

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $28,000, the interest of which is to be used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of students who without such aid would not be able to meet the cost of living as students of the University.

THE FRANK WILLIAMS FUND.

Mr. Frank Williams, E.M., of Johnstown, Pa., a graduate of the course in Mining and Metallurgy of the Class of '87, who died October, 1900, bequeathed to the University the greater part of his estate to found a Fund, the income of which is to be lent to deserving students. The bequest becomes available for this purpose in 1905.

WILBUR PRIZES.

A fund has been established, yielding an annual income of $100, by E. P. Wilbur, Esq., for distribution in prizes as the Faculty shall determine.

THE PRICE PRIZE FOR ENGLISH COMPOSITION.

Dr. Henry R. Price, an Alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the department of English not later than the beginning of the Second Term in each year.

In estimating the value of all such essays the greatest stress will be laid upon clearness of thought and idiomatic force of expression; and, in the judgment of the examiner, while looking for correctness of thought in clear and forcible English, expression will take precedence of ideas. For this specific end, weight will be given to the form rather than to the matter presented.

Competitors must signify their intention not later than the first of April.

The subject for the prize essay in June, 1905, will be: "The Prose Work of Rudyard Kipling."

ALUMNI PRIZES.

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, has with the consent of the contributors been diverted from this purpose and the income will in the future be used for prizes to members of the Junior Class. In June, 1905, two prizes of $25 each will be awarded to the first honor men of the course in Civil Engineering and of the group comprising the Junior students in Analytical Chemistry and Chemical Engineering. In subsequent years the prizes will be awarded to the first honor men of the other technical courses in turn.

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of Lehigh University" established in 1882 an annual sum of $50, to be distributed in prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Alumni Prizes was held on February 22, 1904, with the following competitors:

Clarence Edward Clewell, of Winston-Salem, N. C.

Rexford Archibald Harrower, of Swarthmore.

Michael Henry Kuryla, of Elmira, N. Y.

Norman Nathaniel Merriman, of South Bethlehem.

Horace Schultz Seipt, of Worcester.

Albert Jones Willis, of Philadelphia.

The First Prize was awarded to R. A. Harrower, the Second to M. H. Kuryla, and the Third to H. S. Seipt.

The judges were the Rev. Marcus A. Tolman, of Bethlehem; Prof. George T. Ettinger, of Allentown; and Prof. Samuel E. Berger, '89, of Philadelphia.

WILLIAMS PRIZES IN ENGLISH.

Prof. Edward H. Williams, jr., established in February, 1900, prizes amounting annually to three hundred and thirty-five dol-

lars for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

Sophomore Composition Prizes.

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amounts of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered to that section. If more than one student shall receive the next highest rank in any section where there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

Senior Premiums.

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty—when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or their committee, shall meet on the above date and at subsequent adjourned meetings and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are

up to the standard, and are admitted, they shall declare the contest closed for that year, and no prizes shall be awarded; but the sum of one hundred and fifty dollars, which is in the hands of the President to pay for them, shall be used by him in such manner as he shall see fit to encourage public speaking in the University.

If one or more dissertations are admitted as aforesaid, the Faculty, or their committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or their committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

If fewer than six candidates shall present dissertations, or fewer than six dissertations shall be admitted to the contest, the whole, or such part of the sum of the above one hundred and fifty dollars as shall not be awarded at the close of the contest, and shall remain in the hands of the President, shall be used by him, as aforesaid, to further public speaking in the University, in any manner as he may see fit.

Graduate Prize.

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence and taking post-graduate work in the University, may

select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those which fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded. The sum of one hundred and twenty-five dollars in the hands of the President to pay this prize, in the event of its not being awarded, as aforesaid, shall be used by him to further public speaking, as aforesaid, unless, however, he may consider that he has already a sufficient fund in his hands for that purpose. In this latter case, he shall use this above sum of one hundred and twenty-five dollars to encourage public debate in the University in any manner that he may see fit.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University, but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publications must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

STUDENTS.

A.C.—Analytical Chemistry.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Clas.—Classical.
E.E.—Electrical Engineering.
El.Met.—Electrometallurgy.
E.M.—Mining Engineering.
Geol.—Geology.
L.S.—Latin-Scientific.
M.E.—Mechanical Engineering.
Met.—Metallurgical Engineering.

The names in the following lists include all the students who have registered and attended recitations at the University for the current year:

GRADUATE STUDENTS.

	For Degree.	Residence.
Charles Estell Dickerson, B.S.,	M.S.,	Mt. Hermon, Mass.
Arthur Simon Gilmore, B.A.,	M.A.,	Williamsport.
Walter Savage Landis, Met.E.,	M.S.,	Bethlehem.
Herbert A. Rice, C.E.,	M.S.,	South Bethlehem.
Charles E. Rogers, C.E.,	M.S.,	Potsdam, N.Y.
Lucien N. Sullivan, B.S., (*Rose Polytechnic Inst.*)	M.S.,	Bethlehem.
Horace R. Thayer, B.S.,	M.S.,	South Bethlehem.

SENIOR CLASS.

CLASS OF 1905.

	Course.	Residence.
Charles Edward Aldinger,	M.E.,	York.
William Aaron Bachman,	M.E.,	South Bethlehem.
Wilson S. Barley,	C.E.,	Steelton.
Azzel Clark Bennett,	M.E.,	Oneida, N.Y.
Ben Crandall Bentley,	C.E.,	Jackson, O.
John Daniel Berg,	M.E.,	Pittsburg.
Louis Frederick Blume,	E.E.,	Philadelphia.
Robert Amos Boehringer,	C.E.,	Reading.
Walter Emerson Brown,	C.E.,	Mattituck, N.Y.
Frank Horace Browning,	M.E.,	Washington, D.C.
Charles Ely Butz,	E.E.,	Allentown.

Niles Chapman,	M.E.,	Bethlehem.
Herbert Ashmun Church,	C.E.,	Washington, D.C.
Arthur Stevenson Clay,	C.E.,	Philadelphia.
Clarence Edward Clewell,	E.E.,	Winston-Salem, N.C.
Paul Cloke,	E.E.,	Trenton, N.J.
Dean Corsa,	E.M.,	Washington, D.C.
John Adlum Dert,	M.E.,	South Bethlehem.
Emil August Droll,	M.E.,	Plainfield, N.J.
Arthur Edgar,	A.C.,	Scranton.
George Pryor Enke,	M.E.,	Nanticoke.
William Lawrence Estes, jr.,	L.S.,	South Bethlehem.
Samuel Henry Fleming,	E.E.,	Philadelphia.
John Marvin Fouse,	E.M.,	Pittsburg.
Nevin Elwell Funk,	E.E.,	Bloomsburg.
Albert Wesley Gaumer,	C.E.,	Trooper.
Joseph Newlin Gawthorp, jr.,	M.E.,	Wilmington, Del.
Thomas Bragg Gilliam,	M.E.,	Petersburg, Va.
Robert Stanley Goerlich,	Clas.,	Bethlehem.
Nathaniel Cole Harrison,	M.E.,	Petersburg, Va.
Rexford Archibald Harrower,	C.E.,	Swarthmore.
Cameron Douglass Hayes,	E.E.,	Belair, Va.
Walter Hilleroy Henderson,	C.E.,	Rockville, Md.
Robert Garnett Hodgkin,	L.S.,	Falls Church, Va.
Henry William Hoeke,	M.E.,	Washington, D.C.
Elmer Barr Hostetter,	M.E.,	Landis Valley.
Earley McIlhenny Johnson,	E.M.,	Steelton.
John Taggart Jones,	M.E.,	New Castle.
Ray C. Kautz,	E.M.,	Moweaqua, Ill.
Charles Edgar Kendig, E.M.,	E.E.,	Baltimore, Md.
Ralph G. Kirk,	Met.,	Harrisburg.
William Corson Kline,	C.E.,	North Wales.
Harry Oscar Koch,	C.E.,	Tamaqua.
Michael Henry Kuryla,	M.E.,	Elmira, N.Y.
Will Henry Larkin,	M.E.,	Butler.
James Fulton Leonard,	C.E.,	Salisbury, Md.
William Henry Lesser,	M.E.,	Upper Lehigh.
William Henry Lynch, jr.,	C.E.,	Harrisburg.
Wallace Martin,	Clas.,	Paterson, N.J.
James Alexander Mease,	M.E.,	Bethlehem.
Norman Nathaniel Merriman,	L.S.,	South Bethlehem.
George Stickle Mervine,	E.E.,	Philadelphia.

Thomas Benjamin Mickley,	E.E.,	Ballietsville.
Arthur Frederic Murray,	M.E.,	Bethlehem.
Elmer Clinton Pearson, B.A.,	A.C.,	Siegfried.
Harry Laffayette Pentz,	C.E.,	Montoursville.
William Montgomery Person,	C.E.,	Kittrell, N.C.
Earl Victor Phelps,	E.E.,	Washington, D.C.
Edwin Louis Rich,	E.E.,	Washington. D.C.
John A. Ruddy,	C.E.,	Scranton.
Francis C. Ryan,	Met.,	Harrisburg.
George Henry Schaeffer,	E.E.,	Reading.
Edgar Henry Schmidt,	C.E.,	White Haven.
William Russell Schnabel,	C.E.,	Bethlehem.
Carl Theodore Schwarze, B.S., (*Cooper Union.*)	C.E.,	New York, N.Y.
Alan deSchweinitz,	L.S.,	Mechanicsburg.
James Alton Seacrest,	C.E.,	Upton.
Horace Schultz Seipt,	C.E.,	Worcester.
Charles Augustus Shaffer,	M.E.,	Harrisburg.
Joseph Shema,	C.E.,	Baltimore, Md.
George Henry Shenberger,	M.E.,	Manchester.
George Arthur Sisson,	C.E.,	Big Rock, Ill.
Alfred Pollitt Smith,	C.E.,	Baltimore, Md.
Richard Hendon Smith,	E.E.,	Philadelphia.
Frank Bausman Snyder,	M.E.,	Mount Joy.
Ned Herbert Snyder,	M.E.,	Harrisburg.
Richard Ryland Thompson,	C.E.,	Cape May, N.J.
Harry Samuel Walker,	M.E.,	South Bethlehem.
John Henry Walker, A.B., (*Randolph-Macon College.*)	C.E.,	Walkerton, Va.
Clarence Bailey White,	A.C.,	Philadelphia.
Albert Jones Willis,	C.E.,	Philadelphia.
James Hunter Wily,	E.E.,	Pughtown.
James Harold Wolfe,	M.E.,	Philadelphia.
Charles Harold Young,	Clas.,	Floyd, N.Y.

JUNIOR CLASS.

CLASS OF 1906.

Harold Provost Balston,	M.E.,	Brooklyn, N.Y.
William Mace-Douglas Barnes,	E.M.,	Brooklyn, N.Y.
Calvin William Barwis,	C.E.,	Pittsburg.
Mead Reginald Beck,	Clas.,	Bethlehem.
Walter Carl Benedict,	C.E.,	Scranton.

Lewis Samuel Birely,	C.E.,	York Road, Md.
David Herbst Brillhart,	C.E.,	York.
Aubrey Levis Broomall,	E.E.,	Cheyney.
Joseph Anthony Buch,	C.E.,	Santiago, Cuba.
Algernon Raymond Burchsted,	M.E.,	Wollaston, Mass.
Harvey Miller Burkey,	El.Met.,	Reading.
Morton Hazen Chase,	M.E.,	Philadelphia.
Chester Philip Clingerman,	M.E.,	Altoona.
Stewart Joseph Cort,	El.Met.,	Allegheny.
Joseph Frederick Cottrell,	M.E.,	Danville.
William Walton Crawford,	E.E.,	Richmond, Va.
John Summerfield Crowther, jr.,	M.E.,	Cockeysville, Md.
Alfred Warren Cupitt,,	M.E.,	Germantown.
Hart Blayney Daugherty,	C.E.,	Indiana.
Dion Kanouse Dean,	M.E.,	Rahway, N.J.
William Lane DeBaufre,	E.E.,	Baltimore, Md.
Clyde Denlinger,	A.C.,	Strasburg.
Harry Cortland Dent,	M.E.,	Allentown.
John Cyrus Distler,	M.E.,	Baltimore, Md.
Robert Samuel Drummond,	M.E.,	Philadelphia.
Ralph Selden Edmondson,	C.E.,	Titusville.
William Raymond Ehlers,	E.E.,	Baltimore, Md.
Henry Frederick Eigenbrodt,	M.E.,	Baltimore, Md.
Morris de Bertholette Evans,	E.M.,	Reisterstown, Md.
Marcus Martin Farley,	C.E.,	Trenton, N.J.
John Herbert Farrell,	E.M.,	Marquette, Mich.
Thomas George Fear,	M.E.,	Eckley.
Arthur Cobb Flory,	M.E.,	Scranton.
Charles Frederick Gilmore,	Clas.,	Williamsport.
Thomas Leslie Gossling,	E.E.,	Philadelphia.
Estep Tillard Gott,	C.E.,	Scranton.
William Henry Grady,	E.M.,	Rhone.
John Huston Clark Gregg,	C.E.,	Catasauqua.
William Heyward Grimball,	M.E.,	Charleston, S.C.
August Bernard Grubmeyer,	E.E.,	Germantown.
Claude Benneville Hagy,	C.E.,	Reading.
Edwin Paul Hayes,	M.E.,	Eufaula, Ala.
Frank Anderson Henry,	Ch.E.,	Annapolis, Md.
Paul Henry Herman, B.A., (*St. John's College.*)	El.Met.,	Baltimore, Md.
Samuel Hess,	M.E.,	Hellertown.
Jesse Edwards Humphreys,	C.E.,	Philadelphia.
J. G. Hunt Isert,	M.E.,	Louisville, Ky.

Gilbert Garfield Jacobosky,	C.E.,	Wilkes-Barre.
Clarence Arthur Jacoby,	E.E.,	South Bethlehem.
John Richard James,	M.E.,	Wilkes-Barre.
Frank W. Jefferson,	M.E.,	Chesapeake City, Md.
Edward Everett Johnston,	C.E.,	Baltimore, Md.
Milton Day Kirk,	E.M.,	Curwensville.
Thomas Norman Lacey,	E.E.,	Lititz.
Herbert Houghton Lauer,	E.M.,	Philadelphia.
Henry Quimby Layman,	M.E.,	Baltimore, Md.
Harry Riley Lee, B.S., (*Rutgers College.*)	El.Met.,	New Brunswick, N.J.
Charles Wells Lotz,	M.E.,	Reading.
Thomas Harrison Lüders,	M.E.,	Philadelphia.
Roswell Silas McMullen,	C.E.,	Carbondale.
Gilbert Peters McNiff,	E.M.,	Harrisburg.
J. Terence McVey,	C.E.,	Ephrata.
Paul Donald March,	M.E.,	Harrisburg.
Daniel Alfred Maurer,	E.E.,	Minersville.
Thomas Andrew Hammersley Mawhinney,	Clas.,	Philadelphia.
Leopoldo Mercader,	C.E.,	Aguadilla, Porto Rico.
Richard Mansfield Merriman,	C.E.,	South Bethlehem.
Kenneth Mills,	C.E.,	Washington, D.C.
Austin Wilford Moore,	El.Met.,	Scranton.
William Edward Nicholson,	C.E.,	Elmira, N.Y.
Michael William Nolan,	M.E.,	Carbondale.
Clarence Herr Ohlwiler,	A.C.,	Altoona.
John Howard Opp,	C.E.,	Plymouth.
William Marsh Payne,	A.C.,	Elmira, N.Y.
Harry Alexander Peyton,	E.M.,	Washington, D.C.
Harry Weiser Protzeller,	E.E.,	Hokendauqua.
Francis Rogers Pyne,	El.Met.,	Elizabeth, N.J.
George Kunkel Reel,	Met.,	Harrisburg.
Robert Bruce Rench,	E.E.,	Hagerstown, Md.
Richard Roy Renner,	C.E.,	Sharpsburg, Md.
William Henry Roberts,	E.M.,	Bethlehem.
Benjamin Trexler Root,	M.E.,	York.
Charles Edgar Ryder,	C.E.,	Norristown.
Ray Philips Saffold,	E.M.,	Washington, D.C.
Samuel Henry Salisbury, jr.,	A.C.,	Seneca Falls, N.Y.
Carleton Meredith Schoonover,	E.E.,	Bethlehem.
David Norman Showalter,	C.E.,	South Bethlehem.

Marvin White Singer,	M.E.,	South Bethlehem.
George Madison Smartt,	M.E.,	Chattano _a, Tenn.
James Albert Smith,	M.E.,	Newburgh, N.Y.
Newton Guy Smith,	C.E.,	Pottstown.
Judson Gray Smull,	A.C.,	Altoona.
Milton Ellis Spear,	E.E.,	Baltimore, Md.
Persifor Gybbon Spilsbury,	E.M.,	Trenton, N.J.
Harold Tuttle Stearns,	M.E.,	Wilkes Barre.
Howard Raymond Stocker,	C.E.,	Reading.
Christian S. Stouffer,	E.E.,	Sharpsburg, Md.
George Levick Street, jr.,	M.E.,	Richmond, Va.
Edward Russell Tattershall,	C.E.,	White Haven.
Russell Raymond Throp,	M.E.,	Trenton, N.J.
Talbot Todd,	C.E.,	Baltimore, Md.
Charles Nourse Underwood,	M.E.,	Lancaster.
Philip Ricord VanDuyne,	Clas.,	Newark, N.J.
Reenen Jacob van Reenen, B.A., (*Univ. of Cape of Good Hope.*)	C.E.,	Seapoint, South Africa.
Frank Albert Vockrodt,	E.M.,	Pittsburg.
William Julian von Borries,	E.M.,	Louisville, Ky.
Rudolph Walter Vossberg,	M.E.,	Bethlehem.
John Russell Wait,	M.E.,	Roselle, N.J.
John Harvey Wallace,	E.E.,	Philadelphia.
Edgar C. Weinsheimer,	E.M.,	Allentown.
Lee Porter Wray,	C.E.,	Altoona.
Francis German Wrightson, jr.,	C.E.,	Easton, Md.
John James Young, jr.,	C.E.,	Williamsport.

SOPHOMORE CLASS.

CLASS OF 1907.

	Course.	Residence.
Edward Shultz Adams,	M.E.,	Williamsport.
William Drees Aiken,	C.E.,	Bethlehem.
Walter Jacob Ammer,	M.E.,	Baltimore Md.
Harry Frazier Anders,	E.M.,	Frederick, Md.
Frank Pursell Angle,	M.E.,	Danville.
Louis Antonsanti,	M.E.,	San Juan, Porto Rico.
Ralph S. Archibald,	E.M.,	Washington, D.C.
George Milford Baker,	E.E.,	Hagerstown, Md.
George Ormandy Bason,	E.E.,	Sayville, N.Y.
Robert Ashton Bayard,	M.E.,	Washington, D.C.
Grover Esidore Bear,	C.E.,	Fogelsville.

Henry Charles Becker,	C.E.,	Baltimore, Md.
John Warfel Beyer, A.B., (*Franklin and Marshall College.*)	E.E.,	Lancaster.
Lewis Gilbert Bishop,	E.E.,	Bethlehem.
Atherton Bowen,	E.E.,	Pottsville.
John Williams Boyer,	Clas.,	Catasauqua.
Richard Guy Brindle,	M.E.,	Belleville.
John André Brodhead,	M.E.,	Bethlehem.
Paul Lorenzo Brooke,	C.E.,	Pottstown.
Harry Guy Brown,	Ch.E.,	Norfolk, Va.
Stanley Wardwell Brown,	M.E.,	Wilkes-Barre.
Orlando Weathers Bump,	C.E.,	Baltimore, Md.
William Roy Bunting,	C.E.,	Pottstown.
Halsted Woodrow Caldwell,	E.M.,	New York, N.Y.
Carl Ross Camp,	C.E.,	Montrose.
John Bruce Carlock,	E.M.,	Youngstown, O.
Rollin Landis Charles,	L.S.,	Allentown.
Joseph Reed Chew,	C.E.,	Millville, N.J.
Douglass Meeker Clawson,	E.E.,	Mt. Vernon, N.Y.
Robert Emmett Cullen,	C.E.,	Williamsport, Md.
Claude Mahlon Daniels,	C.E.,	Pottstown.
Arthur Albert Davis,	C.E.,	Bethlehem.
Alfred Shaffner DeHuff,	M.E.,	Lebanon.
Henry Daniel Desh,	M.E.,	Bethlehem.
Charles B. Devlin,	A.C.,	South Bethlehem.
Charles Victor Dietz,	E.M.,	Lincoln, Neb.
Samuel Ernest Doak,	E.M.,	Philadelphia.
Frank Leslie Dorr,	C.E.,	Indiana.
Charles Dorrance,	E.M.,	Dorranceton.
William Albert Draper,	C.E.,	Washington, D.C.
George Anthony Dunn,	C.E.,	Philadelphia.
Herbert Pannebecker Dyson,	E.M.,	New Providence.
Wilton Adams Earnshaw,	E.M.,	Lowville, N.Y.
Clarence Lincoln Eastman,	E.E.,	Waterville, N.Y.
George Clinton Edwards,	M.E.,	Elizabeth, N.J.
William Everett Eshelman,	C.E.,	Summerville.
Ben Garfield Evans,	E.E.,	Mahanoy City.
George Withers Evans,	C.E.,	Pottstown.
Oliver Morris Evans, jr.,	C.E.,	Lansdale.
Ambrose Joseph Fasenmyer,	C.E.,	New Bethlehem.
Frank Gabrio Fear,	M.E.,	Eckley.
Raymond Lamur Filbert,	E.E.,	Lebanon.

Edward Staniford Foster,	E.E.,	Bayhead, N.J.
George Edmund Fox,	C.E.,	Pittsburg.
Walter Edmund Frankenfield,	M.E.,	Butztown.
Isadore James Freedman,	L.S.,	Philadelphia.
Joseph Hamilton Galliher,	C.E.,	Washington, D.C.
Theodore Nicholas Gill, jr.,	E.M.,	Washington, D.C.
Ralph John Gilmore,	Clas.,	Williamsport.
Leon Brown Gladden,	E.E.,	Rocks, Md.
Edgar Frederick Gohl,	C.E.,	Harrisburg.
Edward Ralston Goldsborough,	C.E.,	Frederick City, Md.
Edward McConnell Goucher,	C.E.,	Toronto, O.
LeRoy Townsend Grace,	C.E.,	Goshen, N.J.
Rulon James Green,	E.E.,	West Chester.
Augustine Edward Greene,	M.E.,	Bristol, Conn.
Montgomery James Greenough,	C.E.,	Four Paths, Jamaica.
Henry Joseph Groeninger,	C.E.,	Baltimore, Md.
Charles Aaron Gross,	C.E.,	South Bethlehem.
William Seibert Hammaker,	E.E.,	Harrisburg.
John Faber Hanst,	E.M.,	Philadelphia.
Yellott Fitzhugh Hardcastle,	El.Met.,	Easton, Md.
Eugene MacCulloch Hayes,	C.E.,	Louisville, Ky.
James Leslie Hays, jr.,	E.E.,	Trenton, N.J.
Nerias Henry,	E.E.,	Seven Valleys.
George Kurt Herzog,	El.Met.,	Mickleton, N.J.
Alfred William Hesse,	E.M.,	Wheeling, W.Va.
Stanley Walter Hill,	C.E.,	Bethlehem.
William Corcoran Hill,	M.E.,	Pittsburg.
James Allen Hoffman,	M.E.,	Allentown.
Robert Alexander Hooke,	C.E.,	Chattanooga, Tenn.
Frederick Roland Horne,	C.E.,	Plainfield, N.J.
Edgar Philemon Hulse,	M.E.,	Washington, D.C.
William Hunter,	M.E.,	Philadelphia.
Lawrence Wetherill Janeway,	E.M.,	Greensburg.
David William Jardine,	M.E.,	Newington, Ontario.
Earle Frederick Johnson,	C.E.,	Gracedale.
Ellwood Johnson, jr.,	C.E.,	Philadelphia.
George Robert Johnson,	E.E.,	Bayhead, N.J.
Frank Ulrich Kennedy,	C.E.,	Carlisle.
Gordon Eugene Kent,	C.E.,	Rome, N.Y.
Edmund G. King,	C.E.,	Pottsville.
Thomson King,	E.E.	Annapolis, Md.
Ralph Wilhelm Kinsey,	L.S.,	Reading.

George Edmund Kite,	C.E.,	Norristown.
Stanley Bancroft Koch,	El.Met.,	South Bethlehem.
Albert Edward Krause,	M.E.,	Bethlehem.
Ray H. Kressler,	M.E.,	Allentown.
Charles Theodore Kriebel,	E.M.,	Allentown.
Robert Louis Lafferrandre,	A.C.,	Sayville, N.Y.
Daniel Henry Lamke,	C.E.,	Brooklyn, N.Y.
Clifford Barnes Langstroth,	M.E.,	Rahway, N.J.
Alfred William Lawson,	E.E.,	Pottsville.
Charles Henry Leaman,	M.E.,	Reading.
Thomas Minor Lesher,	M.E.,	Easton.
Harry Oliver Lister,	E.M.,	Carbondale.
John G. Loose,	M.E.,	Palmyra.
James English McDevitt,	E.M.,	Lancaster.
Harold Austin McIntosh,	C.E.,	Higland, Kans.
Robert MacMinn,	C.E.,	Williamsport.
Philip Outerbridge McQueen,	C.E.,	Washington, D.C.
Edward Macfarlane,	E.M.,	Towanda.
Robert Upton Paul Mackall,	M.E.,	Washington, D.C.
Arthur Barlow Marshall,	C.E.,	Allegheny.
Albert Jacob Mayer,	M.E.,	Johnstown.
Rodney Augustus Mercur, jr.,	M.E.,	Towanda.
William R. Meyers,	E.M.,	Louisville, Ky.
Levin Alexander Moore,	M.E.,	Bethlehem.
Ledlie Dominick Moore,	E.M.,	Chatham, N.J.
Samuel Rea Morris,	M.E.,	Pottstown.
Leoncio Mosquera, jr.,	C.E.,	Mayaguez, Porto Rico.
Willis Groff Moyer,	E.E.,	Quakertown.
Lawrence Bert Myers,	C.E.,	Philadelphia.
Erie J. Ochs,	A.C.,	Allentown.
Percy Stuart Palmer,	C.E.,	Plainfield, N.J.
Everard LeCompte Pattison,	C.E.,	Baltimore, Md.
Nathaniel Ramsay Pennypacker,	E.M.,	Haddonfield, N.J.
Joseph Irving Porter,	E.E.,	Drifton.
Robert Streeter Porter,	C.E.,	Drifton.
Henry James Prechtl,	Clas.,	Elmira, N.Y.
Johathan Harry Price,	E.M.,	Knoxville, Tenn.
Warren Albert Quadenfield,	El.Met.,	South Bethlehem.
Joseph Benson Reynolds,	Clas.,	New Castle.
George Hollingsworth Robinson,	L.S.,	Uniontown.
Philip Rainey Roper,	M.E.,	Petersburg, Va.
Richard Julian Rozzel,	E.E.,	Welbourne, Va.

Clarence Knight Roulston,	C.E.,	Philadelphia.
John Thomas Rowe,	C.E.,	Hampton, Va.
Daniel Saenz,	Ch.E.,	New York, N.Y.
Manuel Teofilo Saldaña,	E.E.,	San Juan, Porto Rico.
Joseph Ralph Scarlett,	C.E.,	Philadelphia.
NormanWillabiHenrySchafer,jr.,	C.E.,	Shamokin.
Martin Henry Schmid,	M.E.,	Washington, D.C.
Truman Gross Schnabel,	Clas.,	Bethlehem.
Edgar Schweitzer,	M.E.,	Bethlehem.
John Denny Scott,	M.E.,	Portland, Ore.
Thomas Richard Senior, jr.,	C.E.,	Washington, D.C.
Oliver Paul Serfass,	E.E.,	South Bethlehem.
Elmer Frederick Shaffer, jr.,	M.E.,	Philadelphia.
Frank Myron Shaw,	M.E.,	Williamsport.
Martin Luther Hoffa Smith,	M.E.,	Reading.
Matthew Lincoln Smith,	C.E.,	Mount Carmel.
Shaler Gordon Smith,	C.E.,	Baltimore, Md.
Walter Crispell Smith,	A.C.,	Kingston, N.Y.
Albert John Spaeth,	C.E.,	Philadelphia.
Garnett Leigh Spratley,	M.E.,	Petersburg, Va.
Jacob William Stair,	M.E.,	York.
Hugh Exton Steele,	M.E.,	Baltimore, Md.
Samuel Strauss,	A.C.,	South Bethlehem.
Bruce Milton Swope,	M.E.,	Harrisburg.
Arthur Stanley Taylor,	Met.,	Bethlehem.
Lewis Thomas,	C.E.,	New Castle.
Walter Atwood Thomas,	E.M.,	Worcester, Mass.
Samuel Harrison Tilghman, B.A. (*St. John's College.*)	C.E.,	Easton, Md.
Geo. Washington LeRoy Travis,	C.E.,	Flushing, N.Y.
Edgar Raymond Treverton,	E.E.,	Carlisle.
Alexander Liggat Tunstall,	M.E.,	Washington, D.C.
Malcolm Henry Ulman,	A.C.,	Williamsport.
Joseph Cole Utley,	M.E.,	Passaic, N.J.
Eugene Eric Valk,	E.E.,	Annapolis, Md.
Joseph Temple Waddill,	E.M.,	Richmond, Va.
Raymond Wadsworth Walters,	Clas.,	Bethlehem.
Roger Kenneth Waters,	E.E.,	Germantown, Md.
William Scott Watson,	M.E.,	Williamsport.
Ira Benjamin Wheeler, jr.,	M.E.,	Elizabeth, N.J.
Chester Harvey Wilcox,	C.E.,	Center Moriches, N.Y.
William Slayton Wilson,	M.E.,	Rochester, N.Y.
John Wood, jr.,	M.E.,	Pottsville.

Roy Beck Woodring,	Clas.,	Allentown.
Lewis Eli Yingst,	C.E.,	Philadelphia.

FRESHMAN CLASS.

CLASS OF 1908.

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William Lippiatt Archer,	C.E.	Mt. Vernon, N.Y.
Oswald Townsend Austen,	El.Met.,	Brooklyn, N.Y.
Charles Franklin Ayer,	C.E.,	Philadelphia.
Bertram Rodenbaugh Bachman,	A.C.,	Phillipsburg, N. J.
Howard Fink Bachman,	C.E.,	South Bethlehem.
Carl Ambrose Baer,	E.E.,	Harrisburg.
Charles Severn Baldwin,	M.E.,	Baltimore, Md.
John Everett Ballenger,	C.E.,	Washington, D.C.
Andrew Provost Balston,	E.M.,	Brooklyn, N.Y.
William Foster Banks,	C.E.,	Middletown.
John Stevenson Barker,	M.E.,	Pittsburg.
Carl George Barth, jr.,	E.M.,	Swarthmore.
Jacob Christian Barth,	M.E.,	Swarthmore.
Harvey Bassler,	Geol.,	Myerstown.
James Silver Bayless,	M.E.,	Baltimore, Md.
William Silver Bayless,	M.E.,	Baltimore, Md.
George Emery Bayliss,	E.E.,	Titusville.
Eduardo Beato,	C.E.,	Havana, Cuba.
Horatio Nelson Beaumont,	C.E.,	Myerstown.
Fred Valentine Bechtel,	E.E.,	Trenton, N.J.
Charles Clyde Behney,	M.E.,	Carlisle.
Russell Davenport Bell,	L.S.,	New Brighton, N.Y.
Paul Herbert Bishop,	E.M.,	Bethlehem.
Raymond Clarence Bixler,	M.E.,	Freemansburg,
Charles William Blazer,	E.E.,	Newton, N.J.
Jacob Engle Book,	C.E.,	Lancaster.
James Joseph Boyle,	Ch.E.,	Freeland.
Walter Charles Brennan,	C.E.,	Wilkes-Barre.
Clader Blaine Bressler,	E.M.,	Atlantic City, N.J.
Charles Blasius Brickner,	A.C.,	Newton, N.J.
Charles Herbst Brillhart,	E.E.,	York.
George Raleigh Brothers,	L.S.,	Richmond, Va.

Alfred Charles Brown,	C.E.,	Dayton, O.
Conrad Budke, jr.,	E.E.,	St. Louis, Mo.
Louis Budke,	E.E.,	St. Louis, Mo.
Robert Anson Burlingame,	M.E.,	Exeter, N.H.
Frank Cannon,	C.E.,	Allentown.
Patricio T. Cardin,	C.E.,	Portugues, Cuba.
William Franklin Carson,	C.E.,	Philadelphia.
John A. Clarke, jr.,	E.E.,	Philadelphia.
John Henry Clewell, jr.,	Ch.E.,	Winston-Salem, N.C.
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Albert Knowlton Comins,	A.C.,	Wakefield, Mass.
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Eugene Bayliss Corbett, jr.,	Met.,	Nashville, Tenn.
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Noel Guilbert Cunningham,	E.M.,	Watertown, Conn.
Ulysses Simpson Grant Curry,	M.E.,	Pittsburg.
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Warren Cleveland Dietrich,	C.E.,	Shoemakersville.
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James Means Fair,	C.E.,	Saltsburg.
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Augustin Alejo Goytisolo,	E.E.,	Cienfuegos, Cuba.
James Edmund Graham,	A.C.,	Cohoes, N.Y.
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Arthur Henry Hafner,	M.E.,	Bethlehem.
Tobias Cope Harr,	Clas.,	Sellersville.
Evan Ralph Harris,	E.E.,	Lykens.
Harry Kerr Hartzell,	A.C.,	Allentown.
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Lewis Heck,	L.S.,	South Bethlehem.
William Ray Helwig,	C.E.,	Catawissa.
Howard Scott Hipwell,	M.E.,	Reading.
James Francis Hollister,	E.E.,	Locust Gap.
Ernest Edmund Holm,	E.M.,	Philadelphia.
Gilbert Hand Hoppin,	E.E.,	Tomkinsville, N.Y.
Gilbert Henry Hoyt,	M.E.,	Poughkeepsie, N.Y.
Roger Hunt,	E.M.,	Catasauqua.
Howard James Jackson,	C.E.,	Yonkers, N.Y.
Richard Lynex James,	M.E.,	Philadelphia.
Albert Edward Jennings,	M.E.,	Wilkes-Barre.
George Maxwell Jessup,	E.M.,	Scranton.
Norman Lee Johnson,	C.E.,	Elizabeth, N.J.
Edmund Duryea Johnstone,	C.E.,	Hackettstown, N.J.
Adrian Hamilton Jones,	L.S.,	Hazleton.
Paul Daniel Kauffman,	C.E.,	Reading.
William Sutherland Kelton,	M.E.,	Washington, D.C.
George Croney Kiefer,	E.M.,	Baltimore, Md.
Edward Norris Kimball,	E.M.,	Baltimore, Md.
Joseph John Komara,	E.M.,	Johnstown.
Theodore Franklin Kotz,	Clas.,	Nazareth.
Frank Joseph Kraemer,	E.E.,	Frackville.
Arthur Benjamin Lakey,	M.E.,	Philadelphia.
Kenneth Landis,	E.E.,	Carlisle.
Chester John Langdon,	E.M.,	Huntingdon.

Harry William Laubenstein,	M.E.,	Ashland.
Frank P. Laufer,	A.C.,	South Bethlehem.
Henry Fickes Leas,	C.E.,	Topton.
Claude Harland James LeVan,	M.E.,	South Bethlehem.
Fred Schneller Levering,	Clas.,	Bethlehem.
Hobson Thomas Long,	Clas.,	Philadelphia.
George Malsberger Longaker,	A.C.,	Pottstown.
Earl Loomis,	C.E.,	Wilkes-Barre.
Ralph Edwards Loper,	E.E.,	Port Jefferson, N.Y.
Joseph Lores,	E.E.,	Cienfuegos, Cuba.
Alfred Jacob Lowengrund,	E.E.,	Philadelphia.
John Barton Luckie,	E.M.,	Chester.
John Philip Lynch,	Ch.E.,	Newton, N.J.
William Kennedy Lytle,	E.M.,	Pleasantville.
Warren Edward McCann,	M.E.,	Germantown.
William McCleary,	E.M.,	Germantown.
Max McCullough,	E.M.,	Washington, D.C.
Francis Regis McDonnell,	C.E.,	Baltimore, Md.
Ralph Finley McElfresh,	C.E.,	Washington, D.C.
JohnThos.AudenriedMcLaughlin,	M.E.,	Thomas, Ala.
Alexander Joseph McMurtrie,	C.E.,	Ashland.
William Franklin Mackie,	C.E.,	Philadelphia.
Bert Long Madden,	E.E.,	Wilkes-Barre.
John Bernhart Maier,	C.E.,	Royersford.
Clarence Mather,	C.E.,	Trenton, N.J.
John Grant Mathers,	C.E.,	Washington, D.C.
Harry Francis Metzger,	C.E.,	South Bethlehem.
Frank Harvey Miksch,	M.E.,	Bethlehem.
Roy Perry Miles,	C.E.,	Chicopee Falls, Mass.
Robert Nicholas Miller,	L.S.,	Dunmore.
Walter Paul Morrison,	C.E.,	Butler.
Cajetan Morsack,	E.M.,	Roanoke, Va.
Burton Gilbert Morss,	C.E.,	Scranton.
Rudolph John Motz,	C.E.,	Baltimore, Md.
Frederick R. Müller,	E.M.,	Aguas, Calientes, Mexico.
Herbert Stewart Munro,	E.M.,	Philadelphia.
Francis Theodore Nagel,	M.E.,	Baltimore, Md.
Harold Raymond Norton,	E.E.,	Scranton.
Edwardo Augusto Nuñez,	C.E.,	Cienfuegos, Cuba.
Emmet Robinson Olcott,	C.E.,	East Orange, N.J.
William Oram,	C.E.,	Shamokin.
Edwin Calvin Parkhurst,	M.E.,	York.

William Leroy Parsons,	C.E.,	Phoenixville.
Frank Glen Perley,	E.M.,	New York, N.Y.
Evelyn Willing Peters,	C.E.,	South Bethlehem.
Edmund Frederick Petersen,	C.E.,	Washington, D.C.
Andrew Craig Pierce,	C.E.,	Pittsburg.
George Edward Polhemus,	Clas.,	Jamaica, N.Y.
William John Priestley,	M.E.,	Chicopee, Mass.
John Raymond Prizer,	C.E.,	Pottstown.
James Montgomery Raine,	E.M.,	Gladwin, W.Va.
Andrew Carnegie Ramsay,	E.M.,	Greensburg.
Charles Howard Reel,	C.E.,	Harrisburg.
Edwin Eustace Reinke,	Clas.,	Bethlehem.
Solomon Reis,	A.C.,	Wilmington, Del.
Lloyd Elwood Ritter,	E.E.,	Allentown.
John Archibald Robb,	M.E.,	Phoenixville.
George Walter Rommel,	C.E.,	Philadelphia.
Edward Earl Ross,	E.E.,	Philadelphia.
Jonathan Rowland,	C.E.,	Philadelphia.
Camilo Saenz,	M.E.,	New York, N.Y.
Ernesto Sanchez,	C.E.,	Cisneros, Cuba.
Wilson Dibblee Sanderson,	Clas.,	Bethlehem.
Joseph Charles Sandorf,	E.E.,	South Bethlehem.
Ned Hensel Sayford,	C.E.,	Camden, N.J.
Edmund Clarence Schmertz,	M.E.,	Pittsburg.
Theodore Herman Schreiber,	Ch.E.,	Baltimore, Md.
Frank Joseph Schumann,	M.E.,	Bethlehem.
Paul Leon Semmel,	A.C.,	Allentown.
Robert Hoffman Shimer,	M.E.,	Bethlehem.
Stanley Douglass Shimer,	M.E.,	Bethlehem.
Lewis Thompson Shipps,	M.E.,	Bordentown, N.J.
Albert Carman Smith,	E.E.,	Bethlehem.
Andrew Smith,	M.E.,	Stewartsville.
Charles Edie Smith,	E.E.,	Butler.
Humphrey Dillon Smith,	C.E.,	Philadelphia.
Penrose Deily Snyder,	E.M.,	Sellersville.
Thomas Albright Snyder,	M.E.,	South Bethlehem.
Harry Thomas Spengler,	M.E.,	Easton.
Louis Myer Stamilman,	C.E.,	Scranton.
James Stather Stanford,	E.M.,	Great Falls, Mont.
Clarence Louis Stein,	C.E.,	Butler.
William Evans Steiner,	A.C.,	Lebanon.
Samuel George Stem,	Clas.,	Bethlehem.

Edward James Sterner,	M.E.,	South Bethlehem.
Minor Benson Stewart,	Ch.E.,	Warren.
William Brenizer Stites,	C.E.,	Elkins Park.
Delmar Hiram Stocker,	E.E.,	Tunkhannock.
Percy Barclay Storey,	C.E.,	Johnstown.
Carroll Cartee Thomas,	C.E.,	Canterbury, Del.
Edward Post Tooker,	E.M.,	Port Jefferson, N.Y.
Daniel Huston Torrey,	C.E.,	Fort Missoula, Mont.
Richard Hamilton Torrey,	E.M.,	Brooklyn, N.Y.
Arthur William Trembley,	M.E.,	Utica, N.Y.
Frank Edgar Troutman,	M.E.,	Butler.
Robertson Taylor Tunstall,	C.E.,	Baltimore, Md.
Henry Clay Underhill, jr.,	M.E.,	East Aurora, N.Y.
Harry Benno Van Emden,	E.E.,	Brooklyn, N.Y.
Samuel Newbold Van Trump,	C.E.,	Edgemoor, Del.
Albion Noyes Van Vleck,	C.E.,	Linden, Md.
Lloyd A. Walker,	C.E.,	Glade.
Lawrence Alexander Wall,	C.E.,	Harrisburg.
William Haskey Walters,	M.E.,	Quakertown.
Howard George Wascher,	E.E.,	Frackville.
John Henry Westerbeke,	E.M.,	West Sayville, N.Y.
William White,	C.E.,	Camden, N.J.
Frederick James Wilson,	A.C.,	Pittsburg.
Raymond David Benninger Wright,	M.E.,	South Bethlehem.
Karl August Zobel,	E.E.,	Johnstown.
Stanley Albert Zwiebel,	M.E.,	Wilkes-Barre.

SPECIAL STUDENTS.

	Course.	Residence.
Harry Douglass Allen,	A.C.,	Port Henry, N.Y.
Clarence Derrick, B.S., (*Virginia Polytechnic Inst.*)	C.E.,	Houston, Va.
Charles Smith Despard, A.B., (*St. John's College.*)	E.M.,	Parkersburg, W.Va.
Nicholas D. Durdin, M.E., (*Univ. of St. Petersburg.*)	Met.,	St. Petersburg, Russia.
Adrian Davenport Eatherly, B.E., (*Vanderbilt Univ.*)	E.M.,	Nashville, Tenn.
Harry Elias Edmonds, C.E.,	C.E.,	Elmira, N.Y.
William Ansell Ernst,	A.C.,	Vineland, N.J.
Francis Henry Galvin,	E.M.,	Jamaica Plains, Mass.
Julius Reed Hall,	C.E.,	Elmira, N.Y.
Philip Nichola Hartzell,	A.C.,	Allentown.
Carl Emil Lilliestrand,	C.E.,	Hvalfalla, Sweden.
Hugh Norvell Lloyd,	M.E.,	Nashville, Tenn.
Frank William Seward,	E.E.,	Baltimore, Md.
Joseph A. Shellew,	A.C.,	New York, N.Y.
William Harvey Tschappat,	E.E.,	Bethlehem.
Leslie Wiley,	C.E.,	Frankfort, O.
Henry Sherwood Young,	A.C.,	Easton.

SUMMARY OF STUDENTS BY CLASSES AND COURSES.

	Graduates.	Seniors.	Juniors.	Sophomores.	Freshmen.	Specials.	Totals.
Classical	1	3	4	7	8		23
Latin-Scientific	1	4		4	5		14
Civil Engineering	3	27	32	60	73	5	200
Mechanical Engineer.	1	26	35	47	51	1	161
Mining Engineering		4	14	23	35	3	79
Metallurgical Eng	1	2	1	1	1	1	7
Electrometallurgy			6	4	1		11
Electrical Engineering		15	15	26	34	2	92
Analytical Chemistry.		3	5	6	15	5	34
Chemical Engineering			1	2	5		8
Geology					1		1
Totals	7	84	113	180	229	17	630

SUMMARY OF STUDENTS BY STATES.

New Hampshire	1
Massachusetts	7
Connecticut	2
New York	52
New Jersey	42
Pennsylvania	369
Delaware	4
Maryland	53
District of Columbia	27
Virginia	16
West Virginia	3
North Carolina	3
South Carolina	1
Kentucky	4
Tennessee	6
Alabama	2
Ohio	5
Illinois	2
Michigan	2
Kansas	1
Nebraska	1
Missouri	2
Montana	2
Oregon	1
Canada	1
Mexico	2
Cuba	10
Porto Rico	5
Jamaica	1
Sweden	1
Russia	1
South Africa	1
	630

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*Miles Rock, C.E.

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William J. Kerr, A.C., M.E.

*Harry E. Packer, A.C.

Henry R. Price, C.E., M.D., Physician, 1290 Pacific Street, Brooklyn, N.Y.

Henry B. Reed, B.A., M.D., Physician (retired), Milford, Pa.

*William Dunlop Ronaldson, B.A., M.D.

*John M. Thome, C.E., Ph.D.

Russel B. Yates, C.E.

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Edward F. Fassitt, A.C., 153 E. Washington Lane, Germantown, Pa.

* Deceased.

WILLIAM HULL MACCARTHY, B.A., Sec. of the White Mfg. Co., Globe Iron Works, 556 W. 34th St., New York, N.Y. Res: 283 George St., New Haven, Conn.

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WALLACE MCILVAINE SCUDDER, M.E., Editor and Publisher of the Newark *Evening News*, 215 Market St., Newark, N.J. Res: 10 Washington Pl.

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*CARL F. ZOGBAUM, C.E.

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C. WILLIAM MACFARLANE, C.E., Ph.D. (Freiburg i. B. '93). Narberth, Pa.

ROBERT W. MAHON, C.E., Ph.D. (Johns Hopkins), with New York Central & Hudson River R. R., W. Albany, N.Y.

J. J. deGama Malcher, M.E.

Walter Percival Rice, C.E., Consulting Civil Eng'r, 729-732 Society for Savings Bldg., Cleveland, O. Res: 73 Mayfield Road.

Henry Richards, E.M., McFarland St., Dover, N.J.

Lowden W. Richards, M.E., Supt. Iron and Steel Works, Resident Supt., Plate Mill Dept., Saxton Furnace Co., Coatesville, Pa. R.F.D. 1.

Charles L. Taylor, E.M., Chairman, Carnegie Relief Fund, 325 Carnegie Bldg., Pittsburg, Pa.

CLASS OF 1877.

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S. L. Caum, '04.
G. E. Chamberlain, '93.
H. S. Chamberlain, '03.
M. Chamberlain, '00.
E. Chao, '91.
H. B. Chapman, '00.
H. W. Chester, '89.
R. E. Chetwood, jr., '95.
D. H. Childs, '98.

S. W. Chiles, '97.
T. H. Clagett, '97.
C. E. Clapp, '86.
D. B. Clark, '01.
J. J. Clark, '88.
A. H. Clauder, '04.
R. B. Claxton, '73.
H. B. Cleaveland, '04.
F. L. Clerc, '71.
W. P. Cleveland, '90.
A. S. Clift, '95.
F. R. Coates, '90.
G. H. Cobb, '86.
P. L. Cobb, '92.
F. A. Coleman, '92.
W. W. Coleman, '95.
W. J. Collier, '95.
G. P. Connard, '88.
B. T. Converse, '99.
F. L. Cooke, '96.
H. V. Cooke, '83.
M. L. Cooke, '95.
R. G. Cooke, '84.
W. H. Cooke, '85.
W. S. Cope, '90.
*H. St. L. Coppée, '72.
C. W. Corbin, '89.
*J. H. H. Corbin, '69.
J. C. Cornelius, '89.
W. A. Cornelius, '89.
B. A. Cornwell, '04.
J. J. Cort, '03.
M. B. Cory, '04.
G. C. Coutant, '00.
C. E. Coxe, '90.
E. H. Coxe, '91.
J. H. Crane, '01.
W. S. Cranz, '81.
H. M. Crawford, '95.
H. M. S. Cressman, '95.
W. F. Cressman, '93.
W. Cresson, '91.
A. P. Crilly, '81.
F. J. Crilly, '83.
J. P. Croll, '99.
L. Cuesta, '04.
J. B. Cullum, '90.
B. A. Cunningham, '87.
E. S. Cunningham, '96.
J. A. Cunningham, '02.
J. S. Cunningham, '79.
B. O. Curtis, '97.
C. S. Curtis, '03.
S. P. Curtis, '96.
S. D. Cushing, '92.

D

F. A. Daboll, '96.
H. M. Daggett, '98.
J. W. Dalman, '96.
F. W. Dalrymple, '83.
J. M. Daniel, jr., '02.
R. Daniels, '88.
G. Davies, '98.
G. H. Davis, '88.
H. H. Davis, '92.
J. R. Davis, '91.
M. Davis, jr., '92.
W. R. Davis, '92.
W. S. Davis, '88.
W. H. Dean, '86.
C. H. Deans, '89.
W. J. Dech, '93.
H. S. Deck, '95.
P. A. Degener, '03.
R. Degener, '99.
*F. R. C. Degenhart, '72.
W. A. Dehm, '98.
H. DeHuff, '95.
J. W. DeMoyer, '90.
C. M. Denise, '98.
H. Denman, '92.
S. M. Dessauer, '96.
*C. H. Detwiler, '90.

P. H. DeWitt, '88.
S. C. DeWitt, '95.
J. C. Dick, '95.
W. C. Dickerman, '96.
C. E. Dickerson, '89.
E. Diebitsch, '89.
A. A. Diefenderfer, '02.
A. J. Diefenderfer, '03.
H. C. Dilliard, '00.
P. E. Dinan, '97.
A. B. Diven, '94.
E. Diven, '87.
L. Diven, '97.
E. Dodge, '92.
A. C. Dodson, '00.
T. M. Dodson, '00.
M. V. Domenech, '88.
T. J. Donahue, '83.
F. Donaldson, '01.
A. Doolittle, '87.
E. Doolittle, '91.
A. L. Dornin, '04.
J. W. Dougherty, '89.
C. M. Douglas, '93.
H. B. Douglas, '84.
W. J. Douglas, '94.
J. N. Downey, '02.
B. I. Drake, '97.
W. T. Drake, '00.
F. R. Dravo, '87.
G. P. Dravo, '88.
R. M. Dravo, '89.
P. Drayton, '92.
H. S. Drinker, '71.
B. DuBarry, jr., '95.
G. F. Duck, '83.
F. O. Dufour, '96.
W. E. Dunbar, '04.
M. M. Duncan, '80.
C. G. Dunnells, '97.
W. S. Dunscomb, '94.
C. H. Durfee, '93.
E. M. Durham, jr., '96.
E. H. Dutcher, jr., '96.
E. H. DuVivier, '89.

E

J. Eagley, '77.
A. Eavenson, '91.
*H. S. Eckert, '92.
N. Eckert, '00.
H. Eckfeldt, '95.
J. J. Eckfeldt, '98.
A. W. A. Eden, '95.
T. S. Eden, '96.
L. E. Edgar, '98.
H. E. Edmonds, '04.
E. D. Edmonston, '98.
W. N. Edson, '85.
W. A. Ehlers, '01.
E. R. Eichner, '02.
H. W. Eisenhart, '03.
S. R. Elliott, '97.
T. P. Elmore, '94.
L. H. Ely, '92.
N. M. Emery, '99.
L. O. Emmerich, '82.
T. G. Empie, '94.
G. W. Engel, '92.
*J. R. Engelbert, '85.
B. Enright, '93.
G. R. Enscoe, '96.
C. Enzian, '01.
J. de la C. Escobar, '91.
C. Evans, jr., '01.
H. B. Evans, '93.
L. W. Evans, '03.
W. A. Evans, '96.
T. M. Eynon, '81.

F

E. L. Faison, jr., '95.
A. J. Farabaugh, '04.
L. E. Farabaugh, '04.

G. H. Farman, '95.
R. Farnham, jr., '99.
*W. D. Farwell, '89.
E. F. Fassitt, '71.
F. Faust, '94.
M. H. Fehnel, '87.
S. P. Felix, '03.
J. DuB. Ferguson, '94.
C. V. Ferriday, '96.
E. C. Ferriday, '95.
R. Ferriday, '94.
W. Ferris, '95.
C. E. Fink, '90.
F. W. Fink, '86.
A. A. Finkh, '97.
*F. E. Fisher, '90.
F. R. Fisher, '90.
H. S. Fisher, '87.
J. W. Fisher, '04.
W. W. Fitch, '04.
J. W. Fletcher, '00.
C. B. Flory, '96.
J. H. Flory, '01.
R. D. Floyd, '94
C. W. Focht, '88.
H. A. Foering, '90.
W. B. Foote, '84.
A. E. Forstall, '83.
W. Forstall, '91.
C. R. Fountain, '96.
S. R. Fraim, '03.
E. Franco, '01.
J. J. Frank, '94.
G. S. Franklin, '88.
H. W. Frauenthal, '89.
A. H. Frazier, '89.
C. J. Frederici, '04.
K. Frazier, '87.
*T. W. Frederick, '76.
R. McN. Freeman, '00.
S. W. Frescoln, '88.
L. A. Freudenberger, '01.
F. Freyhold, '85.
A. Frick, '03.
E. R. Frisby, '98.
G. H. Frost, '93.
H. LeR. Fryer, '02.
F. P. Fuller, '93.
J. Fuller, '00.
W. B. Fuller, '98.
I. D. Fulmer, '97.

G

*G. L. Gabrio, '95.
L. L. Gadd, '94.
R. F. Gadd, '93.
A. G. Galan, '95.
J. M. G. Galán, '98.
C. Gallardo, '02.
F. M. Gallardo, '97.
J. G. Gandia, '99.
T. J. Gannon, '96.
T. K. R. Gardner, '03.
M. W. Garman, '01.
L. R. Garrison, '04.
H. M. Gassman, '01.
L. P. Gaston, '88.
W. Gates, jr., '88.
J. T. Gavan, '02.
R. E. S. Geare '04.
C. W. Gearhart, '93.
F. B. Gearhart, '01.
W. B. Geiser, '02.
R. E. L. George, '98.
P. Gerhard, '03.
W. D. Gernet, '03.
E. A. Giberga y Galé, '95.
J. J. Gibson, '95.
P. D. Giess, '77.
*J. E. Gilbert, '78.
A. H. Gill, '00.
A. S. Gilmore, '03.
L. T. Girdler, '03.
T. M. Girdler, '01.

J. B. Given, '96.
T. Gjertsen, '92.
F. W. Glading, '94.
A. R. Glancy, '03.
*A. M. Glassel, '77.
P. W. Gleason, '02.
*J. B. Glover, jr., '88.
E. G. Godshalk, '95.
H. H. Godshall, '93.
S. W. Goldschmidt, '03.
N. O. Goldsmith, '83.
F. Golian, '02.
O. S. Good, '97.
R. Goodman, '90.
W. T. Goodnow, '83.
G. K. Goodwin, '04.
W. R. Goss, '95.
R. C. Gotwald, '86.
J. J. Grabbe, '04.
E. G. Grace, '99.
J. W. Grace, jr., '99.
C. A. Gradwohl, '02.
*J. S. Graff, '96.
M. B. Graff, '94.
W. W. Graff, '01.
C. B. Graham, '03.
S. L. Graham, '93.
F. L. Grammer, '89.
W. Gratz, '98.
C. W. Gray, '81.
G. E. Greene, '90.
H. T. Greene, '00.
W. Griffith, '76.
J. S. Griggs, jr., '91.
E. A. Grissinger, '94.
R. S. Griswold, '97.
F. A. Groff, '00.
C. F. Gross, '00.
R. F. Gross, '02.
L. J. H. Grossart, '86.
W. H. Groverman, '96.
P. L. Grubb, '01.
W. B. Grubbe, '00.
*J. A. Gruver, '92.
W. Gummere, '99.
F. H. Gunsolus, '98.
B. Guthrie, '94.

H

W. N. Haas, '01.
M. S. Hachita, '02.
C. W. Haines, '74.
F. T. Haines, '95.
*H. S. Haines, '87.
J. F. Halbach, '75.
B. F. Haldeman, '81.
D. Hall, '96.
W. McC. Hall, '94.
W. R. Hall, '02.
O. J. Haller, '04.
F. D. Hallock, '94
T. G. Hamilton, '95.
M. S. Hanauer, '86.
W. T. Hanly, '97.
W. S. Hanna, '02.
*O. C. Hannum, '99.
A. B. Hanscom, '00.
H. Hardcastle, '88.
T. H. Hardcastle, '80.
W. G. Hare, '98.
S. T. Harleman, '01.
H. W. Harley, '90.
H. T. Harper, '84.
E. S. Harrar, '01.
G. W. Harris, '89.
L. S. Harris, '93.
G. A. Hart, '88.
W. D. Hartshorne, '74.
H. J. Hartzog, '04.
R. R. Harvey, '95.
S. J. Harwi, '86.
F. A. Hausman, '01.
G. S. Hayes, '91.
C. S. Haynes, '93.

H. W. Haynes, '03.
R. Hazel, '98.
S. C. Hazelton, '86.
W. C. Hazlett, '78.
R. W. Heard, '93.
D. G. Hearne, '90.
N. H. Heck, '03.
R. C. H. Heck, '93.
J. S. Hegeman, '02.
I. A. Heikes, '85.
J. S. Heilig, '91.
W. L. Heim, '02.
W. A. Heindle, '91.
J. G. Heinz, '00.
G. M. Heller, '77.
L. Henderson, '89.
T. L. Henry, '95.
A. W. Henshaw, '94.
C. S. Heritage, '04.
A. A. Herr, '74.
H. N. Herr, '96.
R. L. Herrick, '04.
J. F. Hersh, '91.
H. B. Hershey, '98.
J. W. Hertzler, '03.
H. D. Hess, '96.
H. H. Hess, '98.
*H. S. Hess, '95.
A. Y. Hesse, '94.
C. E. Hesse, '89.
H. V. Hesse, '91.
F. Hewett, '02.
W. S. Hiester, '97.
I. M. Higbee, '95.
E. Higgins, '02.
H. H. Hillegass, '84.
F. H. Hilliard, '94.
E. D. Hillman, '98.
C. F. Hinkle, jr, '03.
J. B. Hirst, '04.
W. L. Hiss, jr., '95.
J. B. Hittell, '87.
S. H. Hodges, '04.
J. D. Hoffman, '83.
E. F. Hofford, '84.
W. E. Holcombe, '94.
A. D. Hollingsworth, '00.
*J. S. B. Hollinshead, '90.
M. H. Holz, '94.
M. J. Honan, '00.
P. D. Honeyman, '91.
R. B. Honeyman, '88.
G. G. Hood, '83.
R. N. Hood, '97.
J. T. Hoover, '91.
C. C. Hopkins, '82.
W. Hopkins, '95.
G. L. Hoppes, '83.
H. J. Horn, '98.
G. A. Horne, '99.
L. S. Horner, '98.
R. R. Hornor, '99.
H. S. Houskeeper, '72.
F. K. Houston, '90.
J. M. Howard, '87.
F. P. Howe, '78.
M. A. DeW. Howe, '86.
R. P. Howell, '96.
A. A. Howitz, '94.
C. W. Hudson, '89.
E. M. Huggins, '00.
G. W. Hunsicker, '94.
R. Hunt, '03.
A. C. Hutchinson, '02.
G. C. Hutchinson, '94.
R. P. Hutchinson, '04.

I

H. Ichikawa, '91.
*D. W. Irvine, '95.
H. T. Irwin, '97.

J

G. R. Jackson, '99.
H. L. Jackson, '04.
W. S. Jackson, '96.

C. B. Jacobs, '95.
E. A. Jacoby, '95.
H. S. Jacoby, '77.
W. L. Jacoby, '92.
W. A. James, '95.
J. A. Jardine, '84.
H. S. Jaudon, '95.
W. H. Jaxheimer, '02.
S. H. Jencks, '88.
*G. A. Jenkins, '70.
A. P. Jenks, '97.
A. B. Jessup, '95.
A. E. Jessup, '92.
J. T. Jeter, '80.
J. J. Jimenez, '92.
E. B. John, '95.
W. S. Johns, '02.
A. T. Johnson, '99.
H. S. Johnson, '97.
R. G. Johnson, '04.
V. A. Johnson, '96.
A. Johnston, '89.
A. B. Jones, '94.
B. H. Jones, '94.
C. C. Jones, '87.
H. H. Jones, '97.
H. E. Jordan, '03.
W. R. Jordan, '03.
A. E. Juhler, '91.
E. P. Jump, '01.
C. A. Junken, '86.

K

A. S. Kappella, '95.
D. Kautz, '95.
R. D. Kavanaugh, '04.
W. H. Kavanaugh, '94.
M. A. Keck, '04.
W. B. Keim, '95.
C. L. Keller, '93.
J. S. Kellogg, jr., '89.
J. W. Kellogg, '84.
H. Kemmerling, '91.
C. E. Kendig, '02.
B. M. Kent, '04.
J. M. S. Kerlin, '89.
D. G. Kerr, '84.
W. J. Kerr, '70.
E. A. Keys, '99.
H. E. Kiefer, '92.
W. F. Kiesel, jr., '87.
R. Kimball, '99.
C. F. King, '80.
H. E. Kip, '95.
R. R. Kitchel, '92.
J. W. Kittrell, '87.
A. W. Klein, '99.
J. H. Klinck, '99.
V. W. Kline, '96.
*L. E. Klotz, '72.
H. M. Knapp, '91.
F. N. Kneas, '98.
R. W. Knight, '94.
F. H. Knorr, '87.
S. B. Knox, '93.
B. G. Kodjbanoff, '98.
J. deB. Kops, '83.
J. B. Krause, '98.
L. G. Krause, '01.
P. T. Krause, '04.
R. E. Kresge, '96.
W. V. Kulp, '90.
H. M. Kurtz, '90.

L

S. W. Labrot, '92.
D. H. Lackey, '95.
N. Lafon, '78.
P. A. Lambert, '83.
S. E. Lambert, '89.
W. A. Lambert, '95.
O. M. Lance, '72.
H. K. Landis, '90.
W. S. Landis, '02.

R. S. Landron, '99.
C. A. Langdon, '94.
*S. D. Langdon, '87.
F. B. Langston, '84.
W. Langston, '84.
L. E. Lannan, '95.
G. L. de Lara, '86.
R. E. Laramy, '96.
W. A. Lathrop, '75.
S. T. Laubach, '01.
A. R. Laubenstein, '01.
F. C. Lauderburn, '91.
E. H. Lawall, '82.
J. P. S. Lawrance, '73.
T. H. Lawrence, '98.
J. W. Ledoux, '87.
L. R. Lee, '97.
H. Lefevre, '92.
J. E. Leibfried, '00.
G. C. Leidy, '00.
H. D. Leopold, '94.
C. McK. Leoser, '91.
T. S. Leoser, '90.
W. G. Lessig, '00.
A. E. Lewis, jr., '88.
A. H. Lewis, '95.
G. Lewis, '95.
G. M. Lewis, '03.
H. S. Lewis, '00.
T. Lewis, '97.
J. J. Lincoln, '89.
G. B. Linderman, '87.
*R. P. Linderman, '84.
J. B. Lindsey, jr., '98.
F. F. Lines, '02.
W. A. Linn, '04.
A. E. Lister, '92.
J. E. Litch, '90.
F. J. Littell, '99.
J. E. Little, '94.
C. V. Livingston, '97.
W. J. Lloyd, '92.
J. Lockett, '89.
B. W. Loeb, '95.
F. S. Loeb, '93.
A. Long, '89.
A. F. Loomis, '97.
B. E. Loomis, '96.
C. A. Loomis, '98.
J. T. Loomis, '92.
C. G. Lord, '03.
C. W. Lord, '96.
T. P. Lovering, '95.
M. J. Luch, '02.
C. A. Luckenbach, '86.
C. O. Luckenbach, '94.
O. F. Luckenbach, '01.
C. W. Lüders, '04.
T. W. Lukens, '00.
C. E. T. Lull, '00.
W. A. Lydon, '86.

M

J. B. MacBride, '96.
C. S. MacCalla, '96.
W. T. MacCart, '04.
W. H. MacCarthy, '71.
B. MacNutt, '97.
O. G. MacKnight, '99.
W. T. McCarthy, '00.
H. D. McCaskey, '93.
L. G. McCauley, '04.
J. McCleary, jr., '04.
H. H. McClintic, '88.
M. McClung, jr., '94.
J. A. McClurg, '91.
K. W. McComas, '00.
F. J. McDevitt, '04.
W. A. McFarland, '88.
C. J. McGonigle, '01.
G. K. McGunnegle, '99.
H. L. McIlvain, '88.
R. A. McKee, '95.
C. L. McKenzie, '93.

F. A. McKenzie, '95.
*S. T. McKenzie, '95.
J. D. McPherson, '94.
J. McVey, '02.
W. G. McVey, '00.
C. W. Macfarlane, '76.
W. C. Macfarlane, '04.
E. M. Mack, '04.
J. S. Mack, '88.
C. E. Maeder, '00.
R. W. Mahon, '76.
J. J. deG. Malcher, '76.
H. L. Manley, '92.
C. E. Marks, '03.
W. P. Marr, '93.
C. D. Marshall, '88.
L. H. Marshall, '98.
J. F. Marsteller, '77.
J. VanS. Martenis, '94.
J. J. Martin, '89.
J. P. Martin, '00.
C. E. Martinez, '01.
J. G. Mason, '97.
N. P. Massey, '95.
C. M. Masson, '99.
R. S. Masson, '92.
V. E. Masson, '96.
J. O. Mathewson, '94.
A. S. Maurice, '93.
C. F. Maurice, '95.
G. H. Maurice, '93.
A. E. Meaker, '75.
W. L. Meaker, '99.
W. A. Megraw, '97.
H. S. Meily, '87.
L. D. Menough, '01.
E. A. Mercenario, '97.
*J. F. Merkle, '84.
F. A. Merrick, '91.
*W. S. Merrill, '94.
T. Merriman, '97.
T. A. Merritt, '74.
J. F. Middledith, '99.
E. McC. Milheim, '02.
E. J. Millar, '92.
Charles Henry Miller, '88.
*Charles Henry Miller, '89.
Charles Herbert Miller, '90.
E. F. Miller, '83.
E. T. Miller, '03.
E. W. Miller, '96.
G. P. Miller, '88.
J. E. Miller, '93.
J. M. Miller, '04.
J. S. Miller, '95.
J. Z. Miller, '91.
W. H. Miller, '94.
*J. H. Millholland, '88.
P. D. Millholland, '86.
H. S. Miner, '88.
H. B. de Miranda, '73.
R. F. de Miranda, '72.
*S. Miyahara, '77.
C. L. Moffatt, '04.
C. W. Moffett, '89.
C. A. Moore, '94.
H. J. Moore, '01.
M. de la Mora, '00.
R. de la Mora, '96.
W. F. More, '83.
C. H. Morgan, '96.
E. R. Morgan, '03.
J. F. Morgan, '99.
T. A. Morgan, '04.
W. L. Morgan, '02.
*C. F. Moritz, '98.
A. D. Morris, '95.
H. T. Morris, '91.
R. H. Morris, jr., '89.
W. E. Morris, '89.
J. Morrison, '75.
G. R. Morrow, '00.

H. S. Morrow, '88.
J. A. Morrow, '87.
J. T. Morrow, '89.
N. Morrow, '83.
R. T. Morrow, '82.
C. R. Morss, '04.
L. M. Morss, '04.
C. T. Mosman, '92.
D. L. Mott, '88.
F. D. Mount, '97.
E. T. Murphy, '01.
H. M. P. Murphy, '04.
C. E. P. Murray, '02.
W. S. Murray, '95.
W. H. Mussey, '96.
W. U. Mussina, '04.
H. K. Myers, '84.
J. H. Myers, '96.
W. H. Myers, '03.
W. F. Mylander, '93.

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C. P. Nachod, '97.
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